DISSERTATION

RAND

# *The Rise of HMOs*

*Martin Markovich*



***RAND Graduate School***

# DISSERTATION

RAND

# *The Rise of HMOs*

*Martin Markovich*



**RAND Graduate School**

*This document was submitted as a dissertation in March 2003 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Glenn Melnick (Chair), Gerald F. Kominski, and Robert M. Bell.*

This Ph.D. Thesis is Dedicated to my Wife, Elizabeth Markovich (born Nancy Elizabeth Hoge). She brings God's Love into my life.

The RAND Graduate School dissertation series reproduces dissertations that have been approved by the student's dissertation committee.



Published 2003 by RAND
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
201 North Craig Street, Suite 202, Pittsburgh, PA 15213-1516
RAND URL: http://www.rand.org/
To order RAND documents or to obtain additional information,
contact Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

## PREFACE

This study was performed in partial fulfillment of the requirements of the RAND Graduate School for the degree of Doctor of Philosophy (Ph.D.) in Public Policy Analysis. The work contributes to our understanding of the growth of the HMO industry and of some of the dynamics of the health care sector of the U.S. economy. The findings and conclusions of this study may be of interest to State and Federal legislators, public servants, HMO managers, health economists, health services researchers and others concerned with the financing, organization and operation of our health economy.

# ACKNOWLEDGMENTS

When a project stretches out over many years, the number of people who make contributions, large and small, becomes innumerable. I apologize to the many helpful people whose names are not included here, either because of a failure of memory or simply because of lack of time to list their names and contributions.

My first thanks go to my friend and RGS colleague, Eugene Bryton. Gene helped in numerous ways, technical, conceptual and logistical. I am especially grateful for his comments on draft versions of several chapters and for his assistance with downloading data from the Internet.

Ron Viereck of the General Accounting Office (GAO) was the first person to suggest that I work in the area of managed care, and this thesis would probably not have taken its current shape without his initial impetus. Rich Hamer and the staff of InterStudy Publications in St. Paul, Minnesota provided essential data on HMO enrollment and a great deal of other valuable information. Special thanks go to Bernice Schneider and Sandy Hugenin of Wakulla Travel in Crawfordville, Florida. Bernice and Sandy rented me office space and provided moral support for over 2 years, enabling me to be productive during a difficult period.

I thank my Committee, Glenn Melnick, the Chair, Jerry Kominski and Bob Bell, for all their help. As far as I know, none of them received any benefits whatsoever from their service, but they stuck with the project until its successful conclusion. I wish them well with their current and future projects.

My thanks to the 2 deans of the RAND Graduate School during the period I was a student. Dean Charles Wolf facilitated my Graduate Internship at the Los Angeles GAO office; it was there that I worked for Ron Viereck. Dean Wolf also purchased me a copy of Stata statistical software so that I could continue work after relocating to Florida. Dean Robert Klitgaard was willing to break out of the box and permit me to return to RAND for a 1-month period during 1997-98. Sung-ho Ahn, was my brother in arms, both during the period we were at RAND and during the years of long distance moonlighting on our theses. Others who helped me at RAND include Paul Shekelle, Donna Farley, Grace Carter, Adnan Rahman, Andy Cornell, Dennis Smallwood, Vlad Shkolnikov, Tom Martin, Mike Dardia, Helen Barnes, Lynn Anderson, Mario Juncosa, Lori Parker, Susan Adler, Deebye Meyers, Loren Yager, Joe Bolten, Deborah Hensler, Karen Spritzer, John Arquila, Mike Kennedy, Catherine Jackson, Andrea Steiner, Tim Quinn, Joye Hunter, Jim Hodges and Sue Polich.

My friend Barry Stiefel provided a great deal of encouragement and occasional advice during my Ph.D. studies. Just recently, Barry provided critical help with the word processing and formatting of this rather complex document. Alan Havens shared some of his experiences in getting a Ph.D. and provided considerable support and encouragement. Sandro Tomita was my roommate and an ever good-natured friend during my last year in California. Ruth Given, a comrade who also did her Ph.D. on HMOs, provided encouragement and information over several years. John Hoge and Mike Roberts read draft versions of this thesis and provided support in other ways. Rob Ferris stored my paper files and other materials for several weeks while I was getting settled in Tallahassee. Some of the Floridians who deserve thanks include Nancy Ross and Ann Weichelt of the Agency

for Health Care Administration (AHCA), Rick Murgo of TCC, Nat Wesley of FAMU, Bill Modrow of the FSU library, and Malay Ghosh and Cyndi Garvan of UF.

Much of the intellectual inspiration for this work came from David A. Freedman, the statistician long associated with UC Berkeley. He mostly contributed through his published writings, but I enjoyed speaking to him when he visited RAND and exchanging e-mails with him. Alain Enthoven, a health economist associated with Stanford Business School, played a role parallel to that of Professor Freedman. Professors Everett Rogers, Michael Morrissey and J. Scott Armstrong helped out with specific issues via e-mail or phone. Professor Paul Torrens of UCLA served as the External Reviewer, and he provided a very detailed and insightful review. Lawrence Duffield, Christine Page and Bob Pierce of the Kaiser Permanente system provided important data. Teraj and his staff at TV's Computers sold me the DTK Peer-1630 personal computer and the HP Desk Jet printer on which much of my work was done.

Finally, I'd like to thank Karl Haas and all the musicians, singers, composers and songwriters of the world for the joy and emotion they have brought into my life and the lives of most human beings. Music, song and dance heighten our experience and enliven our awareness of how glorious our existence can be.

## ABSTRACT

The purpose of this research is to determine factors associated with differential HMO enrollment growth across metropolitan statistical areas (MSAs). The study examines 2 periods, 1973-1978 and 1988-1993, during which national HMO enrollment grew substantially. Results for the 2 periods are compared to determine the stability of statistical relationships.

Data was collected for the 75 largest U.S. MSAs as of 1990. The study uses multiple regression to test several hypotheses concerning the association of independent variables with HMO enrollment growth. Hypotheses concerning medical supply variables, hospital costs, per capita income, unionization, employment concentration, net migration, education and location are tested. Because of concerns about endogeneity, the values for medical supply and cost variables at the beginning of each 5-year period are used to estimate HMO market share growth.

The study finds that the availability of physicians and other physician related factors are strongly associated with HMO enrollment growth during the 1973-1978 period, but that is not the case for the 1988-1993 period. For the earlier period, the percent of physicians (in the state) who are in group practice shows the strongest association. On the MSA level, an increase in the number of physicians in group practice by 1% of the physician population is associated with a .17% increase in overall HMO market share. The overall proportion of MDs in the MSA population also generated a statistically significant positive association, as did the overall proportion of RNs. None of the associations found for the 1973-1978 period are found for 1988-1993.

This research strongly suggests that the factors associated with HMO enrollment growth on the MSA level changed in the 10 years between the 2 periods. This finding can be interpreted and understood within the framework of the life cycle of the HMO industry. Even though the national industry was still growing rapidly in 1993, a more detailed examination of that growth suggests that the industry was shifting from growth to maturity. The observed transition from continued growth to slow decline during subsequent years reinforces this suggestion.

TABLE OF CONTENTS:

## Chapter 1: INTRODUCTION

The force that through the green fuse drives the flower drives my green age;
Dylan Thomas[1]

### A. Overview

In our secular society, human health is one of the most important values. This helps explain why the US spends 14% of its GDP on health care. The majority of Americans are vitally concerned about their health. To the extent that people believe that health care institutions and finance mechanisms affect their personal health, they are vitally concerned with these institutions and mechanisms. Many of us are also concerned about the provision and finance of health care for our fellow Americans, and we believe that the health care system reflects the values and merit of our society. Unfortunately, many Americans have no health insurance and must either pay for medical care out of their pockets or go without. This occurs despite federal and state expenditure of hundreds of billions of dollars to provide heath care.

The interest in affordable quality health care was one of the forces driving the rapid expansion of Health Maintenance Organizations (HMOs). Initially, they were seen as a way to reign in spiraling costs and yet deliver quality care. HMOs have succeeded at enrolling a large fraction of the American population, and overall quality of care for HMO enrollees is good. But HMO actions, most of them motivated by the imperative to control costs, have created conflict with providers, consumers and government policy makers. Today, questions about the efficacy and efficiency of HMOs abound. Economic issues include:

- How effective are HMOs in controlling overall costs?
- What sorts of oversight should they have and who should carry it out?
- What lessons can policy analysts and policy makers draw from the HMO phenomenon in order to craft sensible health care policies?

This thesis presents a statistical analysis designed to help address these issues. This chapter begins by giving a brief history of HMOs and presenting the conceptual framework of the analysis. The chapter shows how the conceptual framework motivates and justifies the overall design of the statistical analysis presented in this Ph.D. Thesis. The last section of the chapter presents a brief analysis of the policy framework of this study.

[1] "The Force That Through the Green Fuse Drives the Flower" 1934 Poem.

## B. Brief History of HMOs

A health maintenance organization is defined as "an organization that combines the provision of health insurance and the delivery of health care services." (Given 1994)

Early HMOs and HMO-like institutions developed in the 1930s. They may have had some intellectual roots in the workers' cooperative movement of 19th century England. Early prototypes were found in California, Washington, Oregon, Oklahoma and Washington DC. A certain degree of frontier self reliance still prevailed in the Pacific states and Oklahoma, and that spirit may have contributed to the success of these "cooperative health plans." Employees of the Federal Home Loan Bank organized the Group Health Association (GHA) of Washington DC in 1937.[2] The large social programs instituted under the New Deal must have influenced the organizers, but the GHA was also a non-profit cooperative, not a government program.

The movement grew slowly and fitfully in its first few decades. From the 1940s into the 1970s, the majority of HMO enrollees belonged to the Kaiser system. Industrialist Henry J. Kaiser, working with Dr. Sidney Garfield, offered prepaid health care to the workers who built the Grand Coulee Dam in 1938. During World War II Henry Kaiser became a dominant entrepreneur in the shipbuilding industry, and his health plan enrolled over 100,000 people in California and Oregon. After the war, Kaiser and Garfield marketed the Kaiser Permanente Medical Care Program to other businesses and municipal governments in those two states. When Kaiser moved to Hawaii in 1954, building hotels and a cement plant in his "retirement", Kaiser Permanente came with him and eventually became the 2nd largest health insurer in that state.[3]

One of the reasons HMOs did not grow rapidly at first was resistance from organized medicine. Leaders in the American Medical Association (AMA) and its affiliates believed that cooperative health plans would violate the integrity of medical decision-making and provide inferior care. AMA leaders also feared that these plans would lead to socialized medicine, which they whole-heartedly opposed. Physicians who challenged this orthodoxy by founding or managing a prototype HMO often were excluded from state and county medical societies. GHA physicians were denied admitting privileges by every hospital in Washington DC.[4] State medical associations were able to persuade the legislatures of most states to outlaw cooperative health plans and/or the corporate practice of medicine. In states where such health insurance arrangements were legal, fledgling HMOs had great difficulty attracting a staff of competent and reputable doctors.[5]

However, powered by the determination of Henry Kaiser, Fiorello La Guardia and small cadres of committed managers and physicians in a few cities, the HMO movement survived

---

[2] The Social Transformation of American Medicine (STAM) pp. 302-305

[3] Henry J. Kaiser: Builder in the Modern American West, by Mark S. Foster, 1989, pp.211-218, 254, 266.

[4] In 1943, the US Supreme Court upheld the conviction of the AMA on antitrust violations because of its actions against GHA. But efforts to discourage and discredit HMO physicians continued in following years. STAM p 305

[5] STAM pp. 302-306, Foster, op cit, pp. 219-223.

medical resistance and a variety of attacks.[6] In the 1960s, as the growth of health care expenditures accelerated, the movement attracted new advocates, and several small HMOs were founded. In 1970 there were 37 HMOs in 14 states with an enrollment of 3 million people. The HMO movement had achieved national significance.[7]

In the late 1960s and early 1970s political conservatives embraced the HMO concept as an alternative to socialized medicine.[8] Paul Starr provides an insightful analysis of this development. "A remarkable change had taken place. Prepaid group practice was originally associated with the cooperative movement and dismissed as a utopian, slightly subversive idea. The conservative cost minded critics of medical care now adopted it as a more efficient form of management.[9]"

With support from a broad coalition in Congress, President Nixon secured the passage of the HMO Act of 1973. The Act enabled individual HMOs to receive endorsement (referred to as qualification) from the federal government, and it required employers to offer coverage from at least one federally qualified HMO to all employees (dual choice). However, the dual choice requirement was never enforced, and many large HMOs, including Kaiser, never sought federal qualification. The Act did facilitate growth in HMO enrollment by helping to create several successful HMOs around the country, and it legitimized the HMO concept. This statistical analysis of the years 1973 to 1978 included in this report will shed more light on the effects of the HMO Act, and the Act is discussed further in Chapter 5, section A2, Policy Implications.

For profit businesses and the stock market began to play a major role in the expansion of HMOs in the late 1970s.[10] Newly formed corporations as well as established insurers, such as Prudential, sponsored HMOs in that period. Several members of the Blue Cross Blue Shield system, which was non-profit but had access to substantial bank credit, also started or partnered in new HMOs. The trend toward commercialization accelerated in the 1980s, and in 1992 for profit HMOs surpassed non-profits in enrollment. The availability of capital from the stock market and more aggressive strategies fostered by the profit motive enabled the HMO movement to continue its rapid growth. But the long-term transformation of HMOs from local health care cooperatives to large national corporations also occasioned regret and resentment.

---

[6] Fiorello La Guardia, then Mayor of New York City, played a critical role in establishing the Health Insurance Plan of New York (HIP) to insure city employees in the 1940s. HIP rapidly became the country's 2nd largest HMO and maintained that position until the 1980s. STAM pp 322, 324-326

[7] "From Movement To Industry ..." by Gruber et al, HA, Summer 1988, pp.197-208.

[8] An early example of this trend was Governor Ronald Reagan's use of HMOs in the establishment of the Medi-Cal program, California's version of Medicaid. Although HMOs didn't change the nature of the funding, it was hoped that they would keep costs under control.

[9] STAM pp 395-397. Prepaid group practice (PGP) was the term used to describe Kaiser and other HMOs in the 1960s. HMO was coined by Paul Ellwood and publicized by President Nixon in his February 1971 health insurance proposal.

[10] The commercialization of HMOs was probably more important than the HMO Act, but these 2 developments worked together. "The conservative appropriation of liberal reform in the early seventies opened up HMOs as a field for business development." STAM p. 428.

The HMO bust of 1987 to 1990 interrupted this aggressive growth in both enrollment and capitalization. This was a classic industry shakeout caused by too much growth and ignorant management; 76 HMOs went out of business from 1988 to the middle of 1990. However, well run HMOs continued to prosper, and overall national enrollment continued to grow, albeit at a slower rate. In the 1990s, the national industry resumed impressive growth, with total enrollment increasing from 39 million in 1992 to 79 million in 1998. Continued health care cost escalation and the re-emergence of health insurance reform as a major national issue helped the industry to double in size. In particular, many employers felt they had little choice but to convert to HMO insurance as the low cost alternative in the face of rapidly escalating health insurance premiums.

The cumulative record is remarkable. HMO enrollment exploded from 3 million in 1970 to over 80 million in 1999.[11] This increase equated to a 12 percent increase every single year, and national enrollment did grow every single year during this period. Figure 1-1 shows estimated national HMO enrollment from 1970 to 2000 in 5-year intervals.[12]

While national enrollment grew at a relatively steady rate, the distribution of enrollment across the states and cities of our country remained uneven. At any given time, HMOs would catch on in some metropolitan statistical areas (MSAs or simply cities), but they would attract no enrollment in many other, seemingly comparable, MSAs. The geographic dispersion of enrollment had no obvious or predictable pattern. To some extent, growth concentrated in different regions of the country during different periods. But there always were exceptions. Some MSAs in rapid growth regions would buck the trend, while some cities in other regions would grow much faster than neighboring MSAs.

Today, HMOs provide health insurance to over 75 million Americans. They play a strong role in determining how health care is delivered and how health care dollars are distributed. In particular, HMOs have played the leading role in bringing market competition to health care (Zwanziger et al 2000). HMO enrollment has considerable effects on several aspects of the health care system (Escarce et al 2000). Frequently, HMO enrollment growth has led to substantial reductions in hospital costs and other health care costs (Baker et al 2000, Miller and Luft 2001).

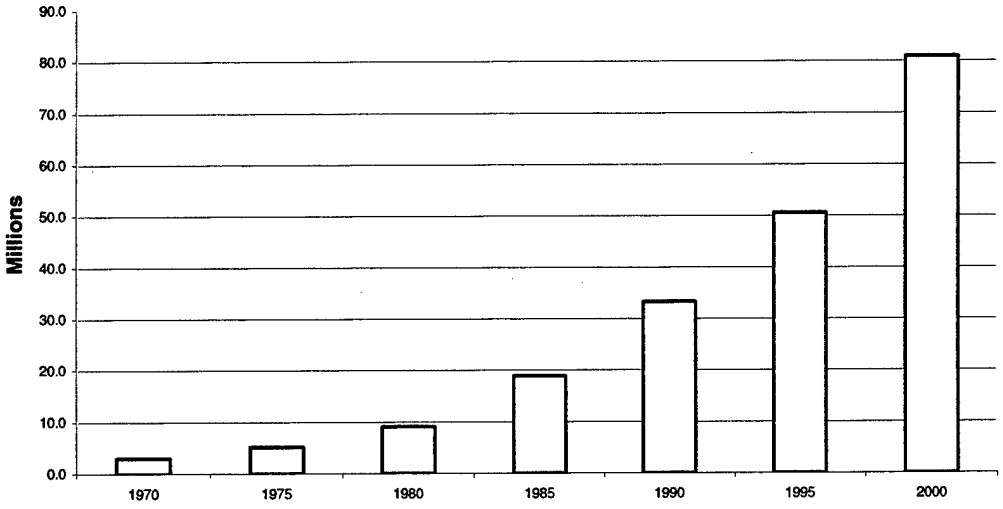
The power and influence of HMOs is a consequence of their large enrollment. This study analyzes the growth of HMO enrollment to determine the causes of that growth. Determining the causes of HMO growth is helpful in determining the root causes of the various effects that stem from increased HMO enrollment.

---

[11] InterStudy Extra, Vol. 1, Issue 4 (December 2000) p.1.

[12] It is now (July 2002) clear that HMO enrollment has plateaued in the past 3 years, and many experts believe it will never surpass the 81 million recorded in 1999. Please see Chapter 5.

**Figure 1-1**
**Growth in US HMO Enrollment**



## C. Diffusion Framework

The growth of the HMO industry is remarkable, but there have been other industries and economic innovations that grew rapidly during the 20th century. Further analysis of the growth of HMOs requires a conceptual framework, and a good framework can highlight the unique, as well as the commonplace, features of the HMO phenomenon. Further insights, which will spring from the statistical analysis of this study, can be placed with the framework to develop a richer and deeper analysis.

Fortunately, there is an extensive literature on the adoption, and non-adoption, of changes in social and economic behavior. This field is generally referred to as the diffusion of innovations.[13] One researcher in this field (LA Brown 1981) has developed an overall framework that can be used to analyze the growth of any innovation or industry. Under Brown's framework (p.27), diffusion is defined by 6 elements:

1) A geographic area
2) A period of time
3) The item being diffused
4) Initial locations of use (Nodes of Origin)
5) New locations of use (Nodes of Destination)
6) Paths or mechanisms of diffusion

Brown, following Hagerstrand (1952), identifies 3 likely patterns for geographic diffusion: a) a hierarchical pattern, where innovations begin in large urban centers and spread out sequentially to medium sized urban centers, suburban areas, etc, b) a contagion pattern, where innovations move in a linear or radial fashion from the point of origin to neighboring areas to further flung areas, and c) a random pattern, where there are no strong geographic regularities.

Brown also highlights the importance of the establishment of "agencies" or organizations that are dedicated to the diffusion of the innovation. In many cases, diffusion of the innovation is not practical without the establishment of such agencies. The Internet and Internet service providers is one conspicuous example. In other cases, the agency itself may be the innovation; Brown cites fast food outlets and regional shopping centers as examples. Brown analyzes 4 factors that determine agency establishment (p.91), namely:

A) Market potential
B) Extent of public exposure to the innovation
C) Characteristics of the organization controlling or coordinating agency establishment, and
D) The role of other institutions

Concerning the dynamic pattern of diffusion, Brown, following Rogers (1962, 1995) and others, notes the ubiquity of the S-shaped curve. The S-shaped curve is frequently observed

[13] Much of the diffusion of innovation literature focuses on the diffusion of very specific technological products and processes. Some of the subject matter and findings are of limited applicability to HMOs. Unlike many growth industries, HMOs did not arise out of any specific physical technology, but out of financial and organizational innovations applied to health care sector. The exposition in the main text relies upon diffusion research that uses a broad definition of innovation and that does apply to HMOs and other industries based primarily on organizational innovations. Full references to the works used are included in the bibliography at the end of Chapter 2.

when adoption, usage or sales are plotted against time. A period of slow initial growth is followed by a period of rapid growth, which is in turn followed by a period of slow growth and possibly a period of stable usage. As pointed out by Rogers (1995) if the cumulative number of adopters follows an S-shaped curve, then the number of new adopters follows the normal bell shaped curve.[14] Rogers divides that bell curve into categories according to the z-scores, or number of standard deviations from the mean time of adoption. This classification scheme works as follows:

| Time of Adoption (Standard Deviations – SDs) | Category | Approximate % of Total Users |
|---|---|---|
| | | |
| 2 or more SDs before the Mean | Innovators | 2.5 |
| From 1 to 2 SDs before the Mean | Early Adopters | 13.5 |
| From 0 to 1 SD before the Mean | Early Majority | 34 |
| From 0 to 1 SD after the Mean | Late Majority | 34 |
| More than 1 SD after the Mean | Laggards | 16 |

In the classical diffusion paradigm, all potential users eventually adopt a meritorious innovation, and the curve levels off at 100% (Rogers 1995, fig 8-4). In this generally non-mathematical literature, the S-shaped is noted as an empirical regularity. However, this curve reflects a logistic pattern of growth, and this pattern has been formally modeled many times for many different contexts (Griliches 1957, Nelson 1968).

Brown borrows from the marketing literature and introduces the product life cycle as a way of analyzing the time path of diffusion. Following Kotler (1972), he divides the life cycle into 4 stages, introduction, growth, maturity and decline. The first 3 of these stages are related to the 3 parts of the S-shaped curve. The introductory period is characterized by slow growth, and the rapid growth period matches the steep part of the S curve. The mature stage then corresponds to the return to slow growth and possible complete flattening out of the S curve. However, the 4$^{th}$ stage, decline, is not normally shown as part of the S curve diagram. The decline stage reflects the reality that commercial products are frequently supplanted by new products that are technologically superior or more appealing to customers.

The product life cycle is a particularly useful concept because it can explain possible changes in the nature of growth as well as in the rate of growth. Brown (1981, 118) states, "Throughout this life cycle diffusion strategies are continually modified regardless of the character of the innovation or of the diffusion agency." In many cases, a company or an industry will essentially market only one product. Therefore the progress of that company or industry will reflect the changing position of the product as it shifts from one stage of its life cycle to another.

Brown illustrates the uses of his framework with several case studies. One of the more interesting ones concerns the growth of the Friendly Ice Cream chain from its origin in Springfield, Massachusetts to most of the Northeast and parts of Ohio. From 1936 to 1964,

[14] Rogers used cumulative number of adopters, assuming that there would not be any dis-adopters. But the same reasoning can be used for other measures of diffusion. Specifically, if increases in sales follow a normal curve over time, then sales per unit of time will follow an S-shaped curve.

the number of Friendly shops grew slowly, and expansion followed a neighborhood pattern. One reason for this was to control the transportation expenses associated with both the delivery of ice cream and movement of headquarters personnel supervising the openings. A regression analysis showed distance from headquarters in Springfield explained 32% of the variance in shop year of opening for the 1936 to 1964 period.

However, Friendly adopted a policy of aggressive expansion in 1965, and the number of shops approximately quadrupled over the next 9 years. For this period, a parallel regression analysis shows that distance from Springfield explained only 21% of the variance in shop year of opening. The regression analysis, as well as other evidence, suggested that Friendly expansion shifted from a cost minimization basis to a sales maximization basis. Equally important, the regression analysis shows that different factors show various degrees of explanatory power, depending on whether shop openings from 1936 to 1964, from 1965 to 1974, or from the entire period, 1936 to 1974, are included in the analysis. This is an example of how statistical analysis can be used to confirm and build upon descriptive analysis using Brown's framework.

The continued applicability of the product life cycle framework is illustrated by a recent report on the personal computer (PC) industry (Silicon Valley/San Jose Business Journal 2002). According to eTForecasts of Illinois, the PC market has completed the growth stage of its life cycle and reached maturity. Worldwide sales may continue to grow, but at a rate of less than 10% per year. The areas with the highest current adoption rates, Western Europe and North America, will have the slowest growth rates in upcoming years. And worldwide sales are likely to shrink during recessions, as happened in 2001. "The PC market is becoming like the car market," states the report's author.

If the PC industry, which is newer and more technological, is reaching maturity, then it is possible the HMO industry is doing the same. With a few minor adjustments, Brown's 6-element framework can be applied to HMO growth at the MSA level. Then the observed temporal and spatial patterns of growth can be used to assess where the national HMO industry, and the HMO product, stand in terms of product life cycle.

## D. Application of Diffusion Framework

Brown's framework is used to help structure this study of HMO growth and of explanatory factors associated with HMO growth. This section goes through the 6 elements of innovation diffusion and delineates how they apply to this study. Then the 4 factors determining agency establishment, labeled A-D, are related to hypothesized explanations for HMO growth. The section also discusses the possible implications of study results for analysis of the product life cycle of HMOs.

The first 2 elements of the framework are geography and time. For HMOs, it is logical to study growth within metropolitan statistical areas (MSAs), since they closely correspond to the markets within which HMOs compete. For convenience, the terms "MSA" and "city" are used interchangeably in this report. The availability of data on many cities permits the application of statistical techniques, notably multiple regression and testing for statistical significance. Because of the issue of endogeneity, discussed in Chapter 3, it was decided to study HMO growth over 5 year periods. Another factor in this decision is that a 5 year period is sufficiently long to generate a materially meaningful effect, but not so long as to unnecessarily increase the risk that changes in structural relationships will contaminate the accuracy and interpretation of the results.

The 3rd element is the innovative item itself. The nature of HMOs and how it has affected their diffusion is discussed at several points in this dissertation. HMOs are defined and their history is described earlier in this chapter. The evolution of HMOs is considered in Chapter 2, Literature Review, and more detail on how their enrollment is defined and measured is provided in Chapter 3, Research Methods and Data.

Brown defines the 4th and 5th elements as the initial locations and new locations of use. Some modifications to these elements are necessary to apply them to a statistical study of HMOs. For HMOs, the extent of diffusion is best measured by number of enrolled lives per geographic area. In order to compare total HMO enrollments across cities, it is desirable to divide enrollment by total population, generating HMO market share in percentage points for each MSA. Therefore element 4 is changed from "Initial locations of use" to "Initial market share" for any given city and element 5 is changed from "New locations of use" to "End-of-period market share". With these modifications, the concept for measuring HMO growth becomes clear. Growth is determined by comparing end-of-period market share with initial market share.

The 6th element is the set of paths or mechanisms that enable the item to diffuse. In Brown's framework, these can be classified in terms of the 4 factor categories that determine agency establishment, A) market potential, B) public exposure, C) characteristics of the coordinating agency and D) the roles of other institutions. With minimal adjustment, these categories apply to the HMO industry.

There is a distinction between the establishment of new HMOs and total growth in enrollment. But, in practical terms, any factor hypothesized to influence the establishment of a 1st HMO in a city can reasonably be hypothesized to influence total growth in that city's HMO enrollment or vice versa. Brown's concept for factor C is that a central agency coordinates the

establishment of local agencies to diffuse the innovation; the characteristics of the central agency naturally influence the establishment of the local agencies.[15] This can be extended to consider how the characteristics of individual HMO influence its growth in enrollment and possibly the total growth in HMO enrollment in its metropolitan area.

This study focuses on general factors A and D, namely market potential and the role of other institutions. Concerning market potential, many variables can be hypothesized to determine or influence the potential HMO enrollment for a given MSA. These include the standard economic and demographic characteristics of a city's population, such as per capita income, population density and average schooling. They can also include variables measuring the supply of health care in that city and other variables that reflect how the health care system works, for example measures of health care expenditures.

However, certain health system variables are best thought of in terms of Brown's factor D, the role of other institutions. Most prominent among these are variables reflecting the characteristics of the metropolitan area's physician population. The relationship between the HMO industry and the physician profession has always been critical to the success and evolution of the industry. As shown in section B of this chapter, active and vigorous resistance by the A.M.A. and its affiliates played a major role in preventing the growth of HMOs for much of the 20th century. Since the 1970s, the relationship between HMOs and the physician profession has been more complex, and a variety of factors influenced the decisions of individual physicians to affiliate or not to affiliate with an HMO (LD Brown 1983).

During the 1970s, new HMOs faced the challenge of attracting sufficient physicians and the right kind of physicians to become functional and grow. By the 1990s, most HMOs had contractual relationships with large number of physicians. But 1990s HMOs felt pressure to contract with virtually all physicians in their geographic areas. Additionally, specific contractual provisions varied widely depending on the metropolitan area and the specific physician group or organization under contract (Robinson 1999). Even though the specific issues changed, HMOs still needed strong business relationships with physicians. Chapter 2 provides further detail on the relationship between HMOs and the physician profession.

Several variables included in this study are hypothesized to affect relationships between HMOs and physicians and affect HMO growth. MDs per capita is a basic parameter that provides a rough indication of the over- or under-supply of physicians in each metropolitan area. Other physician variables include the percent of MDs in group practice, the percent of MDs who fell within the ages of 45 to 64, the percent of MDs who were AMA members and percent of MDs who were family physicians. Please see chapter 3 for more detail concerning these variables and the specific hypotheses related to them.

Factors B and C in LA Brown's diffusion framework are not subject to statistical testing within this study. Factor B is exposure of the public, or of decision makers and opinion leaders, to the HMO concept prior to growth in enrollment. There is no systematic data available with

[15] Brown raises this specific formulation in the course of a case study of the opening of Planned Parenthood outlets under the supervision of the Planned Parenthood Federation of America. It clearly also applies to his Friendly Ice Cream case study and to an agricultural case study where a statewide organization determined distribution routes for a liquid form of cattle feed.

which to distinguish between different MSAs in terms of this factor.[16] Factor C is the characteristics of individual HMOs. Data on some of the characteristics of individual HMOs, especially model type and ownership, is available. However, the collection, processing and analysis of this data have not been performed as part of this study.

This conceptual framework includes product life cycle as a common influence on the diffusion of a product, and HMOs have been around long enough to go through different life cycle stages. It is desirable to consider the possible effects of an overt or latent change in life cycle stage on HMO enrollment. In this study this is done by analyzing 2 distinct time periods, 1973-78 and 1988-93. The period of the mid 1970s is relatively early in the HMO growth curve. During this period, 19 large and medium sized cities, including Houston, Miami, Pittsburgh and Salt Lake City, saw their first HMO enrollee, and national HMO enrollment passed 5 million. On the other hand, by 1993, HMOs were operating in the 75 largest U.S. cities, and enrollment had passed 40 million. As discussed in Chapter 2, HMOs also went through numerous structural and functional changes during the 1973 to 1993 period.

Therefore the statistical analysis may reveal the effects of a change in life cycle stage between the two periods. If the causal factors for the two periods are similar, this will suggest that HMOs remained in the same stage of product life cycle, presumably a growth stage, throughout the 20-year period. If the two sets of causal factors are dissimilar, this will suggest that there may have been a change in life cycle stage, or that such a change was latent within the industry. For example, a shift from the growth stage to the maturity stage may have begun by 1993. The possibility of change in life cycle stage, and other applications of the diffusion framework to this statistical analysis of HMO growth, is discussed in Chapter 5, Conclusions.

In sum, this study seeks to provide insights into the growth of HMOs during the period from 1973 to 1993, and a framework based on the diffusion of innovations literature is used to help interpret the results. HMO growth in 75 MSAs is analyzed for two 5-year periods, 1973-78 and 1988-93. Explanatory variables are selected to reflect a number of hypotheses concerning the major influences on HMO growth, but all of the hypotheses relate to MSA market potential or to the role of other health care institutions in HMO growth. Ordinary least squares regression, with precautions taken to pre-empt endogeneity, is the statistical method. The full details on research methods and data are presented in Chapter 3.

[16] In the diffusion of innovation literature, exposure to the new item is frequently measured by detailed prospective studies in which a large number of potential users are interviewed and their decision-making processes are carefully tracked (Roger 1995, 31-35, 52-63). Comparable studies have been done for small samples of HMO enrollees, but no study of this type on a national scale has been published.

## E. Policy Framework

One of the primary considerations in US health policy is the cost-access paradox. Our country spends more on health care than any other nation, but 14% of the population lacks health insurance. The years 1992 to 1994 saw major efforts to resolve this paradox at both federal and state levels. A near consensus emerged that facilitating and encouraging the continued growth of HMOs would be a key element in improving our health finance system.[17]

The comprehensive policy initiatives of 1992 to 1994 were not implemented, but national HMO enrollment continued to grow until 1999. Much of the health care policy debate continued to focus on HMOs. But more recent policy initiatives have primarily been intended to restrict them and limit their freedom. For example, various state legislation has permitted patients to appeal HMO decisions, mandated that they offer certain benefits, or dictated the terms of their provider contracts. In 2001, legislation with similar provisions passed in the US Senate and House.[18]

The development, implementation and modification of policy is complex. In a very simplified model, policies are implemented to meet societal goals. However, the policy-making process must also define the appropriate scope of the policy, the details which translate a general policy into reality, which organizations will implement the policy and how long it will take for the policy to be implemented and have the desired effect. In other words, policy analysis must consider the where, how, who and when of implementation as well as the basic what and why of promoting the general welfare.

This thesis is most relevant to the policy issue of controlling costs. However, it also touches on a few other policy issues.

### *Controlling Costs*

In the 1970s, the HMO movement became a major concern of policy analysts and policy researchers for one primary reason – the desire to control health care costs. One reason policy makers focus on controlling costs is that government programs bear a significant fraction of overall costs; increasing costs mean increased fiscal pressure on federal, state and, to some extent, local governments. Second, the percentage of Gross Domestic Product (GDP) devoted to health care has risen dramatically.

---

[17] During this period many analysts and politicians embraced the doctrine of managed competition, associated with Alain Enthoven. The managed competition prescription relied heavily on widespread enrollment in HMOs, with government and private employers regulating HMO plans in specified ways.

Enthoven maintained that managed competition would control costs and make it possible for employers and government to provide insurance to the uninsured. Seemingly, savings from cost control could be applied to improve access to care. One analysis found that all uninsured persons could be covered with an increase of only 2 or 3% of health care expenditures. See "The Uninsured Access Gap ..." by Long and Marquis, HA, Spring II, 1994, pp.211-220.

[18] New York Times (NYT) "Bill Establishing Patients' Rights Passes in Senate", June 30, 2001, p. A1; MSNBC.com "House Passes Patients Rights Bill", August 2, 2001 (www.msnbc.com/news/588651.asp, may no longer be available). However, the differences between the House and Senate versions were not resolved, and no new legislation was enacted during the 2001 Congressional session.

Figure 1-2 shows the growth in health care expenditures relative to GDP from 1950 to 2000 at 10-year intervals. Early in the cold war, health care accounted for about 4% of the US total. This percentage has grown in every decade since, with the most rapid growth during the 1960s and 1980s.
Table 1-1 shows similar material in more detail, presenting GDP, rate of economic growth, health expenditures, rate of growth of health expenditures per capita and health expenditures as a percent of GDP for 1950, and from 1960 to 2000 at 5-year intervals. The story is simple and consistent, with only adjustments for inflation and population growth requiring substantive calculations. In every 5-year period from 1950 to 1995, health expenditures have grown more quickly than overall economic production. The margin of faster growth varied from .2 percent from 1950 to 1955 to 4.6 percent from 1965 to 1970. However, overall economic growth somewhat outstripped the growth of health expenditures from 1995 to 2000.

To some extent, the growth in costs can be justified by numerous new technologies and improvement in global outcomes such as life expectancy. But economists and social critics have argued that the increase in value was not commensurate to the increase in costs. In the early 1970s, the cost-access paradox became a dominant issue in the United States and Canada. Canada responded by socializing health insurance, but not the provision of care itself. The U.S. avoided comprehensive socialization and developed a variety of programs and concepts, one of which is reliance upon HMOs.

The effectiveness of HMOs in controlling costs has been the subject of a tremendous volume of research and analysis. This literature is reviewed in Chapter 2. The balance of the evidence indicates that HMOs have reduced overall health care costs through several mechanisms and substantially contributed to the cost de-escalation of the 1990s. This de-escalation has caused cost to recede as an issue in the consciousness of the public, the press, and elected officials. But costs are now increasing at a rapid rate and the issue is starting to re-emerge.

Expected increases in costs over the next several years are likely to cause businesses and government agencies to revitalize their cost-control efforts. But few measures to control costs have been consistently effective (Gold et al 1993). As controlling costs regains urgency, we may see greater advocacy for increased HMO enrollment. Or advocates may call for other institutions to employ the most effective (and most stringent) HMO cost control tools. These include requiring pre-authorization for a) hospitalizations, b) referrals to specialists c) expensive medical procedures, and d) prescription drugs. They also include restricting the network of providers available to a subscriber and reducing reimbursement rates for providers.

*Other Policy Issues*

Which level of government should be responsible for regulating HMOs and deciding related policy questions? Currently federal and state governments share the regulation of HMOs. This division of authority is complex, and for some issues the line between the two levels of government blurs. In developing and recommending policies, objective analysts must consider which level of government best serves the public interest in this area.

Figure 1-2
Growth in Health Expenditures
(as a % of US GDP)

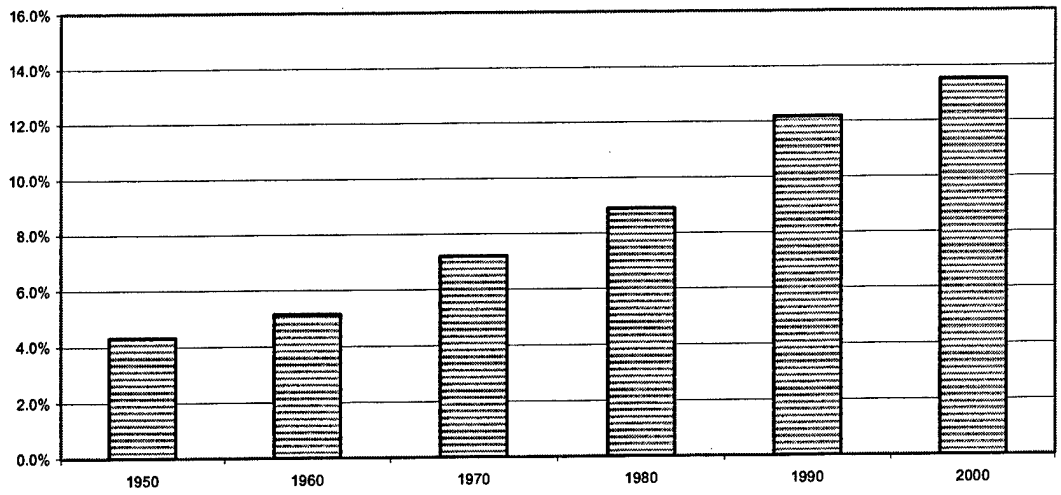



TABLE 1 - 1
US GDP AND HEALTH EXPENDITURES
At 5-Year Intervals from 1950 to 2000

| Year | Nominal GDP | Real GDP | Economic Growth Rate | Health Expends | Real Health Expends | Health Expend Growth Rate | Health Expend as a % of GDP |
|---|---|---|---|---|---|---|---|
| | Bil $ | Bil 1992 $ | %[19] | Bil $ | Bil 1992 $ | % per year[20] | % |
| | | | | | | | |
| 1950 | 287 | 1,570 | n.a. | 12.37 | 67.7 | n.a. | 4.3 |
| 1955 | 407 | 1,962 | 2.8 | 17.75 | 85.6 | 3.0 | 4.4 |
| 1960 | 527 | 2,263 | 1.2 | 27.1 | 116.4 | 4.5 | 5.1 |
| 1965 | 719 | 2,881 | 3.4 | 41.6 | 166.7 | 5.9 | 5.8 |
| 1970 | 1,036 | 3,398 | 2.2 | 74.4 | 244.0 | 6.8 | 7.2 |
| 1975 | 1,631 | 3,874 | 1.6 | 132.9 | 315.7 | 4.2 | 8.1 |
| 1980 | 2,784 | 4,615 | 2.5 | 247.3 | 409.9 | 4.3 | 8.9 |
| 1985 | 4,181 | 5,323 | 2.0 | 422.6 | 538.0 | 4.6 | 10.1 |
| 1990 | 5,744 | 6,136 | 1.9 | 699.5 | 747.2 | 5.8 | 12.2 |
| 1995 | 7,270 | 6,762 | 0.9 | 981.4 | 912.8 | 3.0 | 13.5 |
| 2000 | 9,873[21] | 8,367 | 3.6 | 1,299.5 | 1,101.3 | 2.9 | 13.2 |

[19] Average rate of real economic growth per capita for previous 5 years

[20] Average rate of real growth in health care spending per capita for previous 5 years

[21] Statistics for 2000 based on Levit et al (2002).

Powerful arguments favor standardization and the efficiency of centralized control, and many analyses employ these arguments. Since states tend to be fairly similar in a number of economic and demographic variables, there is a presumption that a consistent policy will tend to work nearly equally well across them. To some extent, the case for state control over policy depends on demonstrating sufficient material differences between states. If there are sufficient differences that influence policy outcomes, then the application of differing policies is justified. Analysts wishing to resolve this issue must either find the variables that justify divergent policies, or they must demonstrate that such variables do not exist.

To take a broader policy perspective, the study of HMO growth can contribute to better understanding of the entire health economy. HMOs have made an enormous impact and attracted a great deal of attention, more data and other evidence are available concerning their growth and evolution than there are for many other phenomena. The HMO industry serves as a valuable case study of the dissemination of an economic form in a sector where new economic forms continue to emerge and evolve.

Additionally, HMOs have played a critical role in disturbing the physician-dominated paradigm of medical care. This paradigm was embodied by the Flexner report of 1910[22] and dominated health care in the US (and influenced its development in numerous other countries) for most of the 20th century. It appears that a new paradigm is emerging, but its essential features remain unclear. Although the future role of HMOs is uncertain, their emergence and their effects on the rest of the health economy hold valuable lessons for all health policy analysts.

[22] Medical Education in the United States and Canada, Bulletin #4, by Abraham Flexner, discussed in STAM, pp 118-121.

## F. Chapter Summary

This dissertation presents a detailed analysis of HMO enrollment over a period of 20 years. This chapter has set the stage by providing descriptive and conceptual background for the analysis. Chapter 2 reviews the extensive literature on the economics of HMOs. Chapter 3 describes how the analysis for this study was conducted. Chapter 4 presents the results of the analysis. Chapter 5 presents the meaning of the analysis for policy analysts and researchers.

The first 2 sections of this chapter, the overview and the brief history of HMOs, underline the importance of this subject. The overview describes how HMOs relate to the health policy dilemma of tremendous costs juxtaposed with widespread lack of health insurance. The history of HMOs emphasizes their scattered beginnings, their spectacular growth during the 1970s, 1980s and 1990s, and their importance today. The next 2 sections describe and apply a diffusion framework that can be used to help understand the growth of HMOs. Prior to now, no publication has used this framework to analyze the HMO industry. Finally, this chapter offers a policy framework to facilitate the use of analytic results to address policy issues. This policy framework emphasizes the role of HMOs in controlling health care costs, but the growth pattern of HMOs also relates to other policy issues.

The most important conclusions from this chapter are that HMO enrollment is an important and interesting subject of study, that the diffusion framework can be used to understand this subject and that understanding the pattern of HMO enrollment growth is likely to help in the understanding and evaluation of health policy issues.

## Chapter 2: LITERATURE REVIEW

You have to study a great deal to know a little.
Montesquieu[23]

This chapter focuses upon the economic studies of HMOs that provide the background for the research performed here. Specifically, it discusses the nature of HMOs' cost advantage over other types of health insurance, the role of market power, the evolution of HMOs and previous studies examining differential growth across geographic areas.

Some of the literature used as background for this project was discussed in Chapter 1, Introduction. In particular, the diffusion of innovations academic tradition, which is mostly concerned with innovations outside of health care, was used to generate a framework for analyzing HMO growth and outlining the statistical design of this study. By contrast, this chapter focuses almost exclusively on health economic publications. However, there are some logical connections between these 2 diverse literatures, and those connections are discussed toward the end of Section A and in Section B of this chapter.

### A. Nature of Cost Advantage

Much of the policy interest in HMOs rises from the belief that they offer a way to reduce health care costs or at least slow the rate of cost growth. Therefore the literature on the extent and nature of cost growth forms a critical backdrop to this project. This section discusses the cost advantage of HMOs. It begins with some basic observations and reviews concepts, methodology and major findings in that order.[24]

#### A1. BASIC OBSERVATION

Basic economics of HMOs begins with the observation that HMOs charge lower premiums and out-of-pocket costs than seemingly comparable fee for service (FFS) plans. This was demonstrated by Luft (1978), which included a review of prior literature. Luft found that costs per capita for HMOs were usually 10-40% lower than for FFS plans. Most of this difference stemmed from a lower hospitalization rate by HMOs. Combining the insurance and provision functions in one organization means that HMOs avoid incentives to treat that providers paid by indemnity insurance have.

Miller and Luft (1994) updated and expanded the previous article with a review of the published record of 54 studies. Concerning utilization, the authors found some evidence that HMOs had lower hospital admission rates and strong evidence that hospital length of stay is lower for HMO enrollees. Evidence concerning physician office visits was mixed, but substantial data indicated that HMOs use fewer particularly expensive procedures, tests, and treatments.

---

[23] Thoughts and Unpublished Writings of Montesquieu, published in French, 1899.

[24] Different studies use different terms and assumptions, but their methods and findings are presented here using a common terminology. Issues of cost savings are purely quantitative, and they can only be resolved through mathematical exposition. Therefore, Thesis Appendix B, The Algebra of HMO Cost Estimation, addresses some of the major issues in a rigorous manner.

Miller and Luft could not reach a conclusion with regard to health care expenditures and health insurance premiums. More recent studies have found that HMOs generate cost savings in the 5-15% range (Baker et al. 2000; Polsky and Nicholson 2001). However, the overall level of premiums is much higher than it was 30 years ago, and most non-HMO plans now employ some managed care methods. Therefore the dollar savings from enrolling in most HMOs instead of a generous FFS plan may well be as much as or more than it was during earlier phases of the HMO movement.

A2. CONCEPTS

The initial hypothesis advanced by HMO advocates in the 1960s was that HMOs achieved their savings by reducing or eliminating unnecessary or counter-predictive health care. This concept is sometimes referred to as the utilization hypothesis. But selection is a major factor in the operation of health insurance markets (Akerlof 1970; Rothschild and Stiglitz 1976; Shain 1966). A contrasting hypothesis holds that HMOs have a natural advantage in invoking selection and that the superior health of HMO enrollees accounts for the lower costs.

HMOs can ensure favorable selection in a variety of ways. But a key concept is that HMOs start out offering some combination of restricted utilization and lower quality care for lower premiums. This approach attracts healthy individuals (or employers with healthy employees), who find the financial savings sufficient to justify the slight risk of being seriously harmed by inferior HMO care.[25] As these low-cost persons enroll in HMOs, they leave high-cost enrollees in FFS plans, and the difference in premiums grows. Possibly, the metropolitan areas in which HMOs succeeded in exploiting favorable selection are the ones in which they have grown most.

Besides possibly enjoying a selection effect, HMOs may also create a competitive effect. Quite simply, HMO competition may spur FFS plans to cut their costs. Unlike any effects from reduced utilization or favorable selection, the hypothesized competition effect would not change the value of HMO premiums. Therefore, studies that just focus on HMO premiums cannot test for the competition effect. However, any competition effect should be observed in both the premiums of other health insurers and in overall health care costs within an MSA or a state.

The selection effect may explain observed rates of HMO insurance premiums. The competition effect may explain observed rates of FFS insurance premiums. Logically, these two hypotheses are independent. In particular, it might be that HMOs have been able to undercut FFS insurance premiums by invoking favorable selection, *and* that FFS plans have responded by reducing their costs by greater efficiency or some other mechanism. It is also possible that HMOs and FFS plans have entered into intense competition for the least risky health insurance policyholders.[26]

---

[25] This argument would most apply to healthy persons who are risk prone, risk neutral, or only moderately risk averse.

[26] And plausibly, because of this competition, both categories of insurers have become more selective in their enrollment and thus reduced the percentage of the population with private insurance coverage.

If we concentrate upon explaining HMO premiums *per se,* the utilization and selection hypotheses are normally associated with different value judgments concerning HMOs. Reducing unnecessary utilization is tautologically good, while exploiting favorable selection is almost always viewed as a social evil.[27] A third hypothesis is that HMOs do not reduce utilization, but they do reduce reimbursement to providers. This hypothesis implies that HMOs are able to use market power to prevail upon providers to dispense equivalent treatments for reduced reimbursement. If the reimbursement hypothesis is true, the associated value judgment is less clear. It depends upon what group of individuals ultimately secures the resources "taken away" from providers and a subjective evaluation of the merits of providing that group with those resources.[28]

Even though utilization, selection, and now reimbursement are conceived of as competing hypotheses to explain observed HMO premium rates, all three may be true. After a brief discussion of methodology, section A4 presents findings concerning these three hypotheses. A number of individual studies have sought to estimate the extent of the selection effect, and, until recently, the absence of a selection effect was taken imply that cost differences were generated by the utilization effect. Only one recent article, still unpublished, estimates the magnitude of the reimbursement effect (Polsky and Nicholson 2001).

## A3. METHODOLOGY

Because extensive data are available on HMO enrollment and on health insurance premiums or health care costs, in principle, it is possible to test whether HMO reduced costs result from favorable selection or other causes. The empirical analysis can be conducted on three levels: individual, provider, or market.[29] Each has advantages and drawbacks. In the next section, we consider outstanding examples of studies on all three levels.

Table 2-1 summarizes three levels of analysis and their qualities. Analyses at the provider level and the market level are similar in that they both use HMO market share in a geographic area as the independent variable and a cost related measure as the response variable.[30] As noted in the table, these two levels of analysis both incur the risk of endogeneity; endogeneity occurs when the response variable contributes to variability in the independent variables. However, the two types of studies differ fundamentally in their control variables.

---

[27] Possibly a necessary evil if other benefits, associated with a free market, are to be enjoyed.

[28] For example, some (but not all) of the funds transferred from providers could go to HMO executives' salaries and stock options. Or the funds might be appropriated to HMO enrollees in the form of lower premium payments and higher wages. Another issue concerns how providers adjust their behavior in response to the reduced reimbursement. According to a recent press report, an unpublished study finds that the uninsured in high managed care areas "have greater difficulty accessing care than the uninsured in areas with lower managed care penetration." American Health Line, 5/21/01, #8.

[29] A 4th possible level would be by employer. Few studies have been conducted on this level probably because of difficulties in securing employer level cost records from insurance companies or because of distrust of the concept of matching comparable employers. One such study was Feldman et al, 1993.

[30] Usually HMO costs aren't distinguished from FFS costs because it is very difficult to do so on either the provider or market levels. One study, Wholey et al 1995, was able to estimate HMO costs on the market level. With the right combination of cost data and a credible model of how the selection and competition effects work, it is possible to determine if HMOs reduce global costs and to estimate how much.

## Table 2-1: Alternative Levels of Analysis

Comparing Costs for HMO and FFS Enrollees

*Methods that control for Selection effects*

| Method | Advantages | Drawbacks |
|---|---|---|
| 1. Individual<br>2 variants:<br>a) Randomly Assign<br>b) Compare Switchers with non-Switchers | 1) Possibility of analyzing costs in detail - i.e. Hospital vs Pharmaceutical, etc.<br>Primarily applying to Variant b[31]:<br>2) Possibility of knowing sample in detail, and, if necessary, controlling for numerous individual attributes.<br>3) Possibility of surveying subjects for reasons switched, health status, satisfaction, etc. | 1) Samples are usually small and non-representative of Universe (US Population).<br>2) Difficulty of following the same individuals over a period of years.<br>3) Will not naturally measure the competition effect, though it may be possible to do so. |
| 2. Provider<br>Regress a provider-specific measure or correlate of costs on HMO Market Share or growth thereof | 1) Controls for characteristics of individual providers.<br>2) Will show competition effect.<br>3) May be possible to keep better track of units than with individual consumers.<br>4) Potential for greater n, but see drawback 1).<br>5) Many components and correlates of costs could be analyzed this way to get the most complete picture. | 1) 'Phony inflation of n. Since providers in an MSA tend to be highly correlated, residuals are probably not independent.<br>2) Any provider-specific measure will have only a weak relationship with total health costs.<br>3) Endogeneity<br>4) Ignorance of proper control variables.<br>5) Inconsistency of HMOs across geo units. |
| 3. Regional<br>(Usually MSA or County)<br>Regress total hospital costs[32] by geographic area on HMO Mkt Share/Growth | 1) Study population can include large numbers of persons and is perceived to be representative of US universe.<br>2) Will capture competition effect.<br>3) Units can be consistently defined over a period of years, but see drawback 6. | 1) Small number of observations until recently.<br>2) Problems with comprehensiveness and accuracy of cost data.<br>3) Endogeneity<br>4) Ignorance of proper control variables.<br>5) Inconsistency of HMOs across geo units.<br>6) Consistently defined geo units do not necessarily imply populations that are congruent over time. |

[31] Special advantages of random assignment are well known. In brief, the singular advantage is the likely elimination of *all* differences in confounding variables, whether those variables are recognized and measured or not.

[32] Total health care costs for MSAs, Counties or smaller units are generally not available.

With provider level data, it is possible to control for provider specific characteristics that may influence health costs. Market studies can include provider characteristics aggregated to the market level, but controlling for each provider's attributes facilitates more accurate estimation of the true effects of the control variables, subject to the required assumptions.[33] However, the use of a large number of providers for purposes of testing the statistical significance of HMO generated cost effects may be misleading, since the residuals for providers within geographical units may be highly correlated.

Random assignment of individuals to HMO and FFS plans is the easiest way to compare costs with the assurance that selection does not influence the results. However, this has only been done once and is unlikely to be repeated any time soon.[34] Thus studies on the individual level mostly use retrospective data. When HMOs were growing rapidly, it was easier to compare persons who switched from FFS to HMO with those who have not.[35]

Individual studies promise greater precision in the analysis of control variables.[36] Finally, individual level data permit comparison between a population exclusively enrolled in HMOs and one exclusively enrolled in FFS plans.

However, individual studies also suffer from drawbacks relative to market-wide studies. Individual studies usually involve individuals enrolled in a small number of plans in one or two markets. The internal validity, though strong, only applies to a small population, and the external validity is weak. Additionally, individual studies suffer from attrition, which most likely is not random, and any competition effect that HMOs have in reducing FFS costs may be difficult to isolate in an individual study.

## A4. MAJOR FINDINGS

### Individual Studies

The RAND Health Insurance Experiment (HIE) found that favorable selection did not play a role in reduced costs.[37] Enrollees randomly assigned to Group Health Cooperative (GHC) of Seattle incurred expenses about 30% lower than enrollees randomly assigned to generous Fee For Service plans. The GHC experimental group incurred about the same average expenses as a control group of persons with ongoing GHC enrollment, suggesting there was no favorable selection of membership by the cooperative.[38]

---

[33] Particularly that the provider attributes are truly structural, and not merely correlated with unobserved structural variables.

[34] Randomized assignment to health plans usually requires that the experiment pay the costs of health insurance for the subjects in return for their surrender of their freedom of choice; this makes it an extremely expensive research method.

[35] In 1988, Luft and Miller analyzed a number of studies of HMO disenrollees, and there have been more studies since. But the large enrollment in PPOs complicates the analysis.

[36] In social science theory, there is only 1 set of "true" control variables. Therefore individual patient and individual provider studies can't both be right. The easy way out conceptually, which is the hard way out in practice, is to conclude that both sets of control variables are needed.

[37] Manning et al, 1987

[38] However, GHC may not have been typical of all HMOs at the time HIE was conducted. The GHC of that time certainly is not typical, in either its structure or its operation, of HMOs today.

In contrast to the HIE findings, a study of Blue Cross/Blue Shield enrollees who switched to HMOs in the Twin Cities from 1978 to 1981 found considerable favorable selection (Jackson-Beeck and Kleinman 1983). Those who chose to enroll in HMOs when their employers starting offering this option had recorded less than half the hospital days of the majority who remained with Blue Cross/Blue Shield; similarly, defectors to HMOs had incurred only about 60% of the total health care expenses of the those who did not switch. However, the circumstances of the Twin Cities study may limit the validity of the findings. At that time, it was understandable that sickly persons were reluctant to leave a prestigious Blue Cross plan to enroll in a form of insurance that was still novel in the Midwest.

Luft and Miller (1988) attempted to summarize the results of about 50 individual-level studies published in the 1970s and 1980s. A small portion of the results found that HMOs suffer from adverse selection. However, the bulk of the results divided about evenly between findings of statistically significant favorable selection and no findings in either direction. Based on this summary, the authors concluded, "biased selection exists." They were unable to estimate, or even bracket, the magnitude of favorable selection effects.

One very recent study finds no evidence for either selection or utilization effects. Polsky and Nicholson (2001) report that HMO enrollees on the whole are about as healthy and have about the same degree of utilization as non-HMO enrollees. They find that lower HMO premiums are due to the reimbursement effect, to the lower payments that HMOs make to providers. These findings are consistent with previous findings that favorable selection is likely to decline as HMOs grow and enroll more diverse populations (Miller and Luft 1994).[39]

Effects On Overall Expenditures and Its Components:

In principle, when the selection effect dominates, HMOs have little or no effect on overall health care expenditures. However, if lower HMO premiums are the result of reduced utilization, than overall expenditures are lower. Independently, a competition effect that lowers costs for fee-for service insurers would also lower total costs. If lower HMO premiums are the result of a reimbursement effect, then total costs may be lowered, depending upon whether providers are able to make up their reduced HMO reimbursement with higher reimbursement from other insurers.

Numerous studies have attempted to estimate or otherwise understand the effect of HMO growth on health care expenses from retrospective data on an aggregate level. A recent study found that the higher HMO penetration was at the MSA level, the lower both HMO and non-HMO premiums tended to be (Baker et al. 2000). This finding suggests that HMOs do not achieve lower premiums solely by invoking favorable selection. It also rebuts the hypothesis that provider price concessions to HMOs result in higher payments to other insurers. However, a comparable study found that increased HMO market share only leads to lower premiums under certain conditions (Wholey, Feldman and Christianson 1995).[40]

---

[39] In the early 1990s favorable selection may have been most significant in the Medicare population, where overall market share was lower than in the commercially insured population and the average level of health care expenditures was close to four times that of the rest of the population. However, subsequent events suggest that favorable selection declined in that market.

[40] Please see Section B, The Role of Market Power, for further discussion of this article.

Since reliable estimates of total health care costs on the county or MSA level are generally not available, most of these studies have examined a particular aspect or component of costs. For example, expenses not paid through insurance premiums must be covered by out-of-pocket payments. Another recent study examined the estimates of US out-of-pocket health care spending for the years 1990, 1993, 1995 and 1997 (Gabel et al. 2001). Contrary to widespread perceptions, this study found that out-of-pocket payments went down for people with employer-based insurance; the growth of HMO enrollment was a major cause of the decline.

Some of the most frequently studied effects of HMO growth are effects on hospital costs and other hospital attributes. Several works find HMO enrollment had little effect on hospital costs per capita at the MSA level (McLaughlin et al 1984; McLaughlin 1987; McLaughlin 1988a; McLaughlin 1988b). A more recent study by Gaskin and Hadley (1997) found considerable evidence that high levels of HMO enrollment in MSAs reduced hospital cost inflation between 1985 and 1993.[41] Other researchers have found in several studies that increased Preferred Provider Organization (PPO) and HMO enrollment can lead to lower costs under certain conditions (Melnick and Zwanziger 1988; Melnick et al. 1992; Zwanziger, Melnick and Bamezai 2000). Section B discusses these studies. Chernew (1995) studied 1982 and 1987 data and found that growth in HMO enrollment led to a decline in number of hospital beds per MSA.

One study from the 1990s found that high HMO enrollment had ambiguous effects on physician fees and incomes (Baker 1994). The effect of HMO market share on other components of costs deserves further study. The most important components include pharmaceutical prices and costs, the compensation of nurses and other allied health providers and administrative costs. Several recent studies provide additional perspectives on overall costs, but much remains to be resolved (Sheils and Haught 1997; Cutler and Zeckhauser 1997; Sullivan 2000).

Towards Resolution of Conflicting Studies:

The contradictory evidence with respect to the selection, utilization, competition and reimbursement effects may be beyond complete resolution. However, the diffusion of innovation literature, and in particular the categorization scheme for innovation adopters, both presented in Chapter 1, can serve as an analogy to help resolve the conflicting findings concerning favorable selection by HMOs. It has been established that farmers, for example, that adopt innovations earlier than average have certain characteristics that distinguish them from the bulk of their peers (Rogers 1995, 261-266).

Likewise, it is reasonable to expect that persons who enrolled in HMOs early may have had some distinctive characteristics of their own. If these characteristics are primarily the result of favorable selection, this is secondary. The main point is that these findings may only be applicable for a limited time. Just as all the eventual adopters of hybrid corn in Iowa were different than those who started hybridizing early, it is reasonable to hypothesize that, once HMO enrollments reached 20% to 30% of the population, those distinctive characteristics of

[41] Unfortunately, this study was sponsored by the largest national HMO organization, the American Association of Health Plans (AAHP). However, almost all of the data are publicly available, and it should be possible to replicate it.

HMO enrollees would become less pronounced. The later studies, such as Polsky and Nicholson (2001) that find no evidence of favorable selection are consistent with this hypothesis. Likewise, these findings are consistent with the numerous studies, cited above, that find that higher HMO enrollment tends to reduce overall health care costs or some component thereof.

However, the selection process can work both ways, i.e. enrollees have some ability to select insurers even as insurers seek to select enrollees. This process of joint selection may help resolve some of the contradictions in the literature.

Kemper et al. (1999/2000) also found that HMO enrollees had similar health status to subscribers in other insurance plans. However, HMO enrollees differed in income and demographics, being poorer, younger, more likely to be single, and more likely to be a member of a minority group. Most significantly, HMO enrollees differ in *attitudes*. The authors write, "Many more HMO enrollees report that they are willing to trade off provider choice than are people with non-HMO insurance." Much of the rest of the population desires wide choice of providers and convenient access to a broad array of health services, and they are willing to pay for those advantages. Possibly related to attitudes concerning the choice/premium tradeoff, survey data show that about a quarter of the population thinks that HMOs provide bad service to health care consumers (Blendon et al 1998).

This implies that the selection effect does not result exclusively from HMOs enrolling healthier people. Rather, it is at least partly the result of *people who wish to economize on health care costs* enrolling in HMOs for that purpose.[42] This distinction is important because it shows how HMOs may increase total welfare. If HMO premiums were and are lower simply because they enroll healthier people, then HMOs' effect on overall costs and total welfare would be small.[43]

But if selection operates on the basis of consumer preferences as well as health status, then HMOs frequently enroll people who want to save money on health care costs and help them to satisfy their legitimate preferences.[44] If there were no HMOs, these people would only have the options of more expensive insurance or no health insurance at all. If we assume, as a first approximation, that all these people would enroll in more expensive plans, then the effect of HMOs is to reduce health care costs. By contrast, we can assume that many would enroll in

---

[42] The specific finding is that 65% of HMO enrollees, and only 50% of non-HMO enrollees, are willing to trade off provider choice for cost savings. This increased willingness is the most distinct attribute of HMO enrollees. For example, 65% of HMO enrollees and 69% of non-HMO enrollees are married.

Since employers mediate this mechanism, it can only function imperfectly. But more people who are willing to give up provider choice enroll in HMOs one way or another. (Reschovsky 1999/2000).

[43] In fact, if this were true, HMOs might even increase total costs, as some studies have implied. But even if HMOs' lower premiums were entirely attributable to favorable selection, it would still be possible to argue for a competitive effect. It is possible that HMOs, by enrolling many of the healthy, force other plans to be more efficient in the treatment of their enrollees, who are on average less healthy. However, if HMOs truly have no incentive to enroll persons other than the very healthy, the competitive effect on the treatment of the less than very healthy could not be very great.

[44] In the abstract, it is possible for HMOs to reduce policyholders' co-payments while increasing the premiums paid by employers. However, as noted above, Baker et al (2000) indicates otherwise. Because employers defend their own interests, HMOs have had to offer lower premiums hand in hand with lower co-payments to build market share. Since the current trend is for employees to pay a larger share of premiums, it seems unlikely this pattern will change.

more expensive plans but some would forego insurance. Then overall health care costs might be lower, the same as, or higher than we currently observe. However, all those current HMO enrollees who would prefer HMO insurance would be unambiguously worse off.[45] Additionally, a higher percentage of people would be uninsured, so it seems likely that society as a whole would be worse off without HMOs.

Therefore, the evidence indicates that HMOs provide value to many of their enrollees, but HMO insurance is inherently unattractive to much of the rest of the population. This suggests that the natural market for HMO insurance is not the entire population, but a subset whose tastes and circumstances predispose them to enroll. When this inference is placed within the product life cycle framework (LA Brown 1981), it raises the possibility that the HMO industry can reach maturity well before 100% of the population is enrolled. In fact, the size of the natural HMO market is an empirical question, and there is no strong prior reason to believe one particular percentage is "ordained" rather than any other percentage.

In Chapter 1, it was suggested that the HMO industry might have shifted from the growth stage to the maturity stage during the 1990s. The key finding of Kemper et al offers a possible explanation of why the industry would reach maturity with enrollment well below 100% of the population. The research results of this study, presented in Chapter 4 and evaluated in Chapter 5, offer further evidence concerning this key issue.

[45] In this scenario, some persons currently enrolled in HMOs against their preference for more generous coverage would be better off if HMOs were eliminated altogether. However, some with similar preferences would be forced to go without insurance altogether. It seems likely the welfare loss of the latter would at least equal the welfare gain of the former.

## B. The Relationship Between HMOs and Physicians

Given the conflicts between HMOs and physician organizations early in HMO history, it is not surprising that many researchers have focused on the HMO-physician relationship (Luft 1987). The severe legal and other conflicts of the 1940s and 1950s gave way to grudging acceptance of HMOs by organized medicine by the 1970s. However, a degree of tension has continued to characterize the relationship. HMOs need physicians to provide and supervise care, but many physicians, often the majority, have had unfavorable attitudes toward HMOs. Since the 1970s, the relationship between HMOs and the physician profession has been complex, and a variety of factors have influenced the decisions of individual physicians to affiliate or not to affiliate with an HMO.

During the 1970s, entrepreneurs trying to introduce HMO insurance in many cities of the U.S. had considerable difficulty attracting a sufficient core of physicians to make new HMOs functional. In some cases, only under-employed physicians were willing to affiliate. Even if a new HMO was operating and growing, physician recruitment issues often constrained expansion. If newcomer physicians lacked the enthusiasm and commitment of the founding physicians, rapid growth could lead to large losses and financial disaster (LD Brown 1983).

By the 1990s, large numbers of physicians were affiliated with HMOs, and physician relationship issues were somewhat different. In order to keep expanding, HMOs felt pressure to contract with virtually all physicians in their geographic area. Additionally, different physician groups and organizations held vastly divergent attitudes toward capitation risk, utilization management and related operational issues. Therefore, HMOs frequently were asked to cater their contractual arrangements to the evolving norms of different metropolitan areas and the particular tastes of specific physician groups (Robinson 1999).

During the rapid HMO growth of the 1990s, a number of surveys indicated that many physicians had reservations about, or were completely disenchanted with, their relationships with HMOs. Some of the areas where HMOs were most heavily criticized included physician autonomy, authorization policies and evaluation of physician performance (Borowsky et al 1997). There was some indication that physicians who were heavily dependent on HMOs for incomes rated HMOs less favorably than those who received little or no income from HMOs (Baker and Cantor 1993). Certain HMO policies, such as gag clauses, provoked widespread protest and legislative action in a number of states (LA Times 1996). A statistical study found that HMO growth is associated with reductions in the numbers of medical and surgical specialists on the MSA level (Escarce et al 2000).

In conclusion, HMOs' relationship with physicians is a critical area affecting the success and evolution of this industry. There is evidence that the recruitment of physicians was a limiting factor for the growth of HMOs in the 1970s. The relationship issues were somewhat different, but still critical, during the 1990s. During this period of widespread HMO success, many physicians displayed dissatisfaction with, or avoidance of, HMO affiliation. Thus physician relationship issues may still have constrained HMO growth.

## C. Role of Market Power

Today HMOs have a presence in virtually every state, and they enroll over one quarter of the U.S. population. Traditional fee-for-service plans have shrunk to a small percentage of the commercial insurance market, and most people are insured by some type of managed care plan.[46] A strong case has been made that only HMOs and PPOs in competition with each other fully exploit their market power to leverage lower prices from hospitals and doctors (Melnick et al. 1992; Zwanziger et al. 2000).

Melnick et al reached this conclusion by considering HMO and PPO relationships with hospitals. Managed care plans' selective contracting with hospitals, permitted in California since 1982, enables plans to take advantage of excess capacity in competitive hospital markets. Particularly if a small number of plans constitute an oligopsony, the plans tend to extract substantial concessions from hospitals and pass much of the savings onto their policyholders.

The authors analyzed market power factors affecting hospital payments of the California Blue Cross PPO, a large insurer. They found that hospitals with strong market power within their geographic area were able to collect higher fees from the Blue Cross PPO. But if Blue Cross had market power over the hospital (i.e. if Blue Cross provided a high percentage of the hospital's patients), then Blue Cross was able to make lower payments. These results reinforce the authors' hypothesis that hospital charges to insurers, which account for the largest fraction of private health care expenditures, are partly determined by the relative market power of the hospital and of the insurer. They maintain that the same factors would influence HMO payments. Based on this, the authors imply that merger or consolidation of insurance plans would reduce hospital costs. However, mergers or consolidation of hospitals would lead to large hospital price increases. A later study reinforced these conclusions (Zwanziger et al, 2000).

Wholey et al. (1995) took a complementary approach. They found, with some caveats, that the greater the index of competition among HMOs at the county level, the lower HMO premiums are. These results indicated that market forces worked though HMOs to lower overall premiums. However, these authors also found that a higher level of HMO market share without greater competition leads to higher HMO premiums. They attribute this result to adverse selection stemming from the movement of high-risk persons from FFS to HMO insurance as HMO enrollment grows in a given market.

[46] On the role of preferred provider organizations (PPOs), please see "(Loosely) Managed Care Is in Demand", NYT, 9/29/98.

## D. Evolution of HMOs

In the past 30 years, HMOs have undergone three major changes: 1) the shift from Staff/Group models to predominantly IPA models, 2) reduction in ownership by local non-profit bodies, and 3) increasing reimbursement of M.D.s by capitation and FFS instead of salaries. Recent evidence suggests that capitation has peaked as a means of reimbursing physicians (Dudley and Luft 2001).[47] HMOs currently rely upon careful selection of provider networks, negotiated fee for service schedules and utilization review as preferred methods of influencing physicians to help control medical costs.

These changes can be seen as part of the overall evolution of HMOs toward a more business oriented organization, as opposed to the community oriented and paternalistic arrangements that characterized their early years. Some HMOs continue to require referrals by the patient's primary care provider (PCP or gatekeeper), but recent pressure from patients for more convenient and rapid access to care has jeopardized reliance on PCPs (Dudley and Luft 2001). HMOs continue to evolve, and the future may see different aspects and potentials of HMOs coming into prominence.

InterStudy (1994) reported that over two-thirds of HMO enrollees belonged to IPAs or mixed model HMOs that operated predominantly on an IPA basis. Many of these IPAs are owned by national HMO organizations, including those controlled by the Prudential, CIGNA and Aetna insurance companies.

Robinson (1999) analyzed the future evolution of HMOs. He predicted that most HMOs will cease to be separate insurers and that they will become part of large national insurance companies that also offer PPO and perhaps other insurance products. He refers to these companies as multi-market, multi-product health plans. Robinson predicted that continuing efforts of HMOs to own exclusive provider networks would fail. He argued that vertical disintegration will prevail, with hospitals, physicians and HMOs all remaining independent. Robinson also forecast an "upside down" version of managed competition, with employers only contracting with one insurer but giving employees the choice of several plans from that insurer. Robinson's arguments, based primarily on trends observed in the 1990s, seemed compelling at the time, and many multi-product firms, including Blue Cross affiliated insurers, have prospered. However, other evidence, including the difficulties faced by Aetna, the most aggressive multi-product firm, suggests that his scenario may be too simplistic.

[47] Table 2 of this article shows that capitation accounted for 8.4% of total physician revenues in 1996 but only 7.4% in 1999. This article cites of increasing rejection of capitated contracts by large medical groups in California and elsewhere.

## E. Causes of Enrollment Growth

As indicated above, the overwhelming majority of academic studies have focused upon the *effects* of HMO enrollment growth, particularly the effect on health care costs. There is a small body of literature (McNeil and Schlenker 1975, Cromely and Shannon 1981, Wholey et al 1990, and Christianson et al 1991) that addresses the entry and exit of HMOs on the MSA level. This literature address only one aspect of the HMO enrollment growth process, but it provides useful background for the more comprehensive studies.

Cromley and Shannon used discriminant analysis to estimate the establishment of new HMOs during the year 1980 in 243 metropolitan areas. It should be noted that they analyzed new HMO establishment regardless of pre-existing HMO operation in each MSA. Their discriminant model shows that a high population to physician ratio was negatively associated with HMO establishment. This is equivalent to a positive association between physician concentration and HMO establishment. Wholey et al analyzed the effect of state regulations on the entry and exit of HMOs from MSA markets. They found that state regulations could affect the entry and exit rates of HMOs without profoundly affecting the number of HMOs in a market.

Extensive search and review of the literature has only yielded 4 prior studies of the *causes* of growth (Goldberg and Greenberg 1981; Morrissey and Ashby 1982; Welch 1984; Dranove et al 1998). The first 3 cover time periods ending from 1976 to 1980, and their analyses are broadly comparable with this study's analysis of the period from 1973 to 1978. The most recent published study is concerned with explaining total managed care enrollment as of 1994 and 1995. This makes it roughly comparable with the analysis of HMO growth from 1988 to 1993 featured in this report. These 4 articles are summarized and compared in terms of data, methods and results.

Data:

Goldberg and Greenberg (1981) use state level data for 1966 and 1976. The key outcome variable was the percentage of insured persons enrolled in HMOs in 1976. The authors tested several standard economic and demographic measures as explanatory variables. They also used an estimate of hospital costs and estimates of the percentages of physicians in group practice and in state medical societies. Finally, they tested six dummy variables relating to state regulations; these included certificate of need (CON) requirements, requirements that HMOs be non-profit and prohibition against HMO advertising.[48]

Morrissey and Ashby (1982) use MSA-level data from 1975 and 1978 for over 250 MSAs; about 70 of these had an HMO presence at the time. Percentage of population enrolled in all HMOs and the presence of an HMO in an MSA were the dependent variables. This article did not use the legal variables used by Goldberg and Greenberg, but, in some runs, it used 1975 HMO market share to predict 1978 values. Two key explanatory variables were the age of the oldest HMO in the MSA and a measure of medium and large employers. It also used

[48] The 1973 Federal HMO Act exempted HMOs from state restrictions on advertising, so such prohibitions ceased to be a factor after that.

data on the supply of doctors and hospital beds, the ages of doctors, the percentage of doctors and the percentage of employers with 250 or more employees.

Welch (1984) also uses MSA level data, but only considers enrollment in Prepaid Group Practices (PGPs), those HMOs that essentially provided full-time employment to their affiliated physicians. This study analyzed enrollment data for each of the years from 1977 to 1980; during those years PGPs accounted for over 80 percent of HMO enrollment. It used a one-year lag of MSA PGP market share as an independent variable. It used several of the same economic and legal predictor variables as Goldberg and Greenberg.

The more recent study, (Dranove et al 1998) considers combined HMO and PPO penetration (i.e. managed care enrollment and expenditures), using 2 different measures to estimate this value. Using physician survey data, these authors estimate the percent of physician revenues from managed care for 276 MSAs. They also use market research survey data to estimate managed care enrollment for 99 of the larger MSAs. The market research data show a much higher extent of managed care penetration than do the physician revenue data. The authors suggest that this difference is due to managed care enrollees having, on average, lower utilization then enrollees in other types of plans. They regress these 2 outcome variables on 3 variables relating to health care supply and on 10 general economic and demographic variables.

Methods:

Goldberg and Greenberg applied Tobit analysis to the data, arguing that it was appropriate because of the large number of zero values in the dependent variable (limited dependent variable). The final model (Equation 6) excludes several variables that were statistically insignificant and judged unpromising based on previous runs. Morrissey and Ashby basically deal with the limited dependent variable problem by running two separate models, the first for presence of an HMO and the second for HMO market share conditional on presence; both models are constructed on a simple ordinary least squares (OLS) basis. The article presents both models with and without the three-year lag variable.

Welch argues that the only "correct" models include lag variables because adjustment to changes in the environment takes time and therefore HMO market share at any point in time is a product of its prior state and changes in exogenous factors. However, this argument can be disputed on both practical and conceptual grounds. On practical grounds, the lagged values will usually absorb much of the variance in the current values, making it difficult to spot relationships that may be more interesting and specific to health economics.

Conceptually, one would want to use *changes* in the predictor variables if one thinks that they are what drive changes in HMO market share, which Welch did not do. In fact, MSA level changes in variables such as education level or net immigration tend to be incremental and their true effects on HMO market share are probably not measurable. It is robust differences *between* MSAs, if anything, exerting themselves over time that account for the observed differences in HMO market share. Lags in effects occur, but that does not necessarily mean that all models must include lag terms. Welch also uses a double log functional form and Heckman and Lee's estimator for a censored sample; this last is a generalization of Tobit analysis that allows for different effects on probability of existence and on magnitude of enrollment.

Dranove et al address managed care enrollment and growth in the 1990s. Since sampling error is a major issue with their Physician Survey, they apply Weighted Least Squares (WLS) regression.[49] To avoid potential endogeneity, they use supply variable data from 1985 or 1980.[50] They also separately estimated parameters for markets with high and low hospital concentration.

Results:

Most included variables did not pass the test of statistical significance in each of the four studies. Goldberg and Greenberg found four variables were marginally statistically significant (i.e., significant at the 10 percent level); these were unionization of the metro labor force, net migration as a measure of population mobility, hospital costs and the prevalence of physician group practice. Each was positively related to HMO enrollment. The article's Regression 6, which included these four variables and two non-significant state regulation variables, achieved an $R^2$ of 33 percent. The results were slightly better when change in HMO market share from 1966 to 1976 was the dependent variable. The lack of solid statistical significance and the relatively low $R^2$ must have been disappointing, but this article did make a start toward understanding this phenomenon.

Morrissey and Ashby used several of the same variables as Goldberg and Greenberg. Of these, Morrissey and Ashby found a marginally significant *negative* effect for per capita income (Goldberg and Greenberg found no hint of any effect at all). On the other hand, Morrissey and Ashby did not find remotely significant effects for unionization or the prevalence of group practice. Net migration had a statistically significant positive effect on conditional market share.

For other variables, Morrissey and Ashby found solidly statistically significant effects for age, gender and race. Those equations with a three-year lag term found it to have a very significant positive coefficient, with its inclusion raising $R^2$ by .20 to .72. The lag term would probably have had even more effect had not an "Age of Oldest HMO" variable, reflecting the age of the oldest HMO in the MSA, been included in both equations. The inclusion of both of these variables accounted for most of the improvement in $R^2$ over Goldberg and Greenberg.

The lag term is even more significant in Welch, which is to be expected since it is a lag of only one year and the "Age of Oldest HMO" variable is not included. Here the lag explains roughly 50 percent of the variance and has a t-value of about 25. This study shows per capita income to have a negative effect, which attains solid statistical significance in one specification. Significant effects were found for hospital cost and education level (both positive). Three of the included state regulation variables had no significant effects, and restrictions on the employment of physicians were found to have a significant negative effect, as might be surmised. However, CON laws were found to have a significant positive effect, which was

---

[49] They use number of physician respondents to weight their physician survey data. They also applied WLS regression to their market research survey data. It appears that the market research data for some cities are based on sample sizes of 200 or lower.

[50] As explained in Chapter 3 of this report, HMO penetration may influence health care supply variables simultaneous with those variables influencing enrollment. Dranove et al address this problem by using supply data from long before the date of their HMO penetration data. Their method is comparable to the method used in this study.

surprising at first.[51] The author tried running the model without the CON variable, and the other coefficients changed only slightly. $R^2$s for both models were between .80 and .85.

Taken together, the three studies indicate that income has a negative effect on HMO Market Share conditional to HMO existence. The two articles that looked at average hospital cost both found a positive effect. Two studies found substantial evidence of a positive migration effect, while the other (Welch) found a statistically insignificant negative migration effect. The two that looked at group practice found materially positive effects that were not statistically significant in either case. Possibly a meta-analysis could quantify the extent of agreement among these articles and this study.

The results are muddier for the other variables. Population mobility, unionization, lags (discussed above), restrictions on M.D. employment and CONs were each examined by two of the 3 articles. The positive unionization effect was close to significance in Goldberg and Greenberg, but very weak in Morrissey and Ashby. Restrictions on physician employment had virtually no effect in one study, but a significant negative effect in the other.[52]

For the 1990s, Dranove et al find that health care supply variables, particularly hospital concentration, had a substantial effect on managed care penetration. MSAs with high hospital concentration tend to have lower managed care penetration, and there is some indication that hospital concentration may have an effect on the coefficients of the other supply variables (hospital occupancy and extent of solo practice by physicians). However, the authors also find that lowering hospital concentration beyond a certain point may have little effect on managed care penetration. Their results provide moderate evidence that increasing hospital occupancy rates and a greater degree of solo practice by physicians tend to decrease managed care penetration.

Concerning economic and demographic variables, Dranove et al find a negative relationship between managed care penetration and a large non-white population but a positive relationship with college education and urbanization at the MSA level. They also found a non-linear relationship between managed care and firm size, with higher managed care penetration associated with higher concentrations of large firms (over 500 employees) or moderately small firms (20-99 employees).

After my findings are presented in Chapter 4 of this report, Chapter 5 offers a comparison of them with the published findings for both the 1970s and early 1990s periods.

---

[51] Possibly institutional providers were more favorable to CON regulation in states where HMOs were emerging. In such a case, the causality ran from HMO growth to CON regulation rather than vice versa.

[52] Please see Chapter 5, Section B2, Comparison With Prior Studies, for an analysis of how the results generated here compare with those of these three prior studies.

## F. Chapter Summary and Significance

This chapter covers the literature on the economics of HMOs. This literature includes extensive analysis and debate concerning the nature of HMOs' cost advantage. The preponderance of the recent literature indicates that the cost advantage is not solely due to a selection effect. It may be largely due to lower reimbursement to providers. Other major topics include the relationship between HMOs and physicians, the role of market power and the evolution of HMOs. Section E of this chapter covers a small number of studies that analyze the causes of HMO enrollment growth.

The published literature contributes to the main analysis because prior studies and findings were used to generate hypotheses that are tested by this study. The specific hypotheses are discussed in Chapter 3. One important hypothesis is that an abundant supply of physicians was conducive to HMO growth. This hypothesis relates to the literature showing that physician recruitment is a critical prerequisite for HMO success. Another physician variable, prevalence of physician group practice has been found to have some influence on HMO growth in one prior study.

Another major hypothesis is that an abundant supply of hospital beds was conducive to HMO growth. It is well established that HMOs achieve a cost advantage by reducing hospital costs. Additionally, three prior studies found that hospital related variables have an effect on HMO growth.

Because of their lower costs, HMOs have often been thought of as a viable health insurance alternative for working class and lower middle income families and individuals. Two prior studies have provided some indication that per capita income has a negative relationship with HMO growth. Therefore, this hypothesis is emphasized in Chapter 3.

In conclusion, review of the literature reinforces the point that HMOs are an important and unique component of the health economy; they have produced substantial effects on health care costs and other aspects of the health care sector. The literature also suggests several specific hypotheses concerning the causes of HMO growth, and these hypotheses are developed and tested in the next 2 chapters.

## Chapter 3: RESEARCH METHODS AND DATA

"Learn the ABC of science before you try to ascend to its summit."
Ivan P. Pavlov[53]

A major goal of this study is to develop statistical models that account for the observed growth of HMO enrollment. As explained in Chapter 1, the datasets and statistical analysis used here are consistent with a conceptual framework developed from the literature on the diffusion of innovations (LA Brown 1981). This chapter presents considerable additional detail concerning the design of the statistical study and the rationale thereof. Extensive precautions have been taken to maximize the likelihood that the statistical models reflect structural, which is to say causal, relationships between the explanatory and outcome variables.

Rather than presume that all the findings reported here reflect such causal relationships, this chapter, and the subsequent chapters, generally use such terms such as "association", "statistical relationship" and "connection" in preference to "causation" and "structural relationship". The use of the weaker terms reflects the considerable complexity of the relationships under study. Numerous threats to validity must be addressed before asserting that any statistical relationship, no matter how strong, accurately captures a structural economic relationship. Therefore, one of the key purposes of this chapter is to present each reader with sufficient information so that they can judge for themselves whether the observed statistical relationships are structural.

### A. General Study Approach and Scope

This is a study of the causes of HMO growth in 2 periods, 1973-78 and 1988-93. The unit of analysis is the geographic division that corresponds most closely to the market in which HMOs compete, namely the metropolitan statistical area (MSA, referred to colloquially as a city). MSA is the unit which best corresponds to the market in which HMOs compete for enrollees.[54] The study population is the 75 largest MSAs in the US as of 1990. These cities and their estimated populations for the years 1978 and 1993 are listed in Table 3-1.

#### A1 OUTCOME VARIABLE

A basic variable for analyzing the HMO industry is the percent of a population enrolled in HMOs, sometimes referred to as overall HMO market share or HMO penetration. In this study, HMO market share is measured for the entire population of each of the 75 MSAs.[55]

---

[53] He of "Pavlov's Dog" fame, 1936 Bequest.

[54] HMOs generally offer services in an area large enough to include the homes, workplaces and preferred providers for the majority of their potential enrollees. In large and medium sized cities, people frequently cross County lines when commuting or seeking care. The MSA, as defined by the US Census Bureau, is the geographic entity that best corresponds to the HMO market.

[55] It can be argued that it is more useful to only study HMO market share for commercially insured populations. However, there are 2 problems with this. First, HMO is a concept and a movement as well as a narrowly defined economic or legal entity. Enrollment in Medicare and Medicaid HMOs is germane to the advance of this powerful movement. Second, it is difficult to estimate the number of uninsured persons at the MSA level, and this reduces the accuracy of estimates of HMO market share for commercially insured populations.

# TABLE 3-1
# 75 LARGEST METROPOLITAN AREAS
(as of 1990)

| Rank | *Name and Designation** | *Designated State^* | Population 1978 (in 000s) | Population 1993 (in 000s) |
|---|---|---|---|---|
| | | | | |
| 1. | New York CMSA | NY | 18,857 | 19,551 |
| 2. | Los Angeles CMSA | CA | 10,779 | 15,210 |
| 3. | Chicago CMSA | IL | 6,880 | 7,580 |
| 4. | Washington-Baltimore CMSA | DC | 5,535 | 6,598 |
| 5. | San Francisco CMSA | CA | 5,174 | 6,469 |
| 6. | Philadelphia CMSA | PA | 5,684 | 5.941 |
| 7. | Boston CMSA | MA | 5,345 | 5,699 |
| 8. | Detroit CMSA | MI | 5,221 | 5,150 |
| 9. | Dallas CMSA | TX | 2,686 | 4,121 |
| 10. | Houston CMSA | TX | 2,792 | 4,007 |
| 11. | Miami CMSA | FL | 2,370 | 3,353 |
| 12. | Seattle CMSA | WA | 2,155 | 3,122 |
| 13. | Atlanta | GA | 1,952 | 3,093 |
| 14. | San Diego | CA | 1,742 | 2,611 |
| 15. | Cleveland CMSA | OH | 2,593 | 2,514 |
| 16. | Minneapolis-St Paul | MN | 2,094 | 2,572 |
| 17. | St Louis | MO | 2,405 | 2,475 |
| 18. | Phoenix | AZ | 1,394 | 2,392 |
| 19. | Tampa-St Petersburg | FL | 1,445 | 2,136 |
| 20. | Pittsburgh | PA | 2,227 | 2,058 |
| 21. | Denver CMSA | CO | 1,632 | 2,146 |
| 22. | Cincinnati CMSA | OH | 1,645 | 1,802 |
| 23. | Milwaukee CMSA | WI | 1,594 | 1,634 |
| 24. | Kansas City | MO | 1,423 | 1,613 |
| 25. | Portland CMSA | OR | 1,249 | 1,632 |
| 26. | Sacramento CMSA | CA | 1,028 | 1,576 |
| 27. | Norfolk | VA | 842 | 1,547 |
| 28. | Columbus | OH | 1,235 | 1,443 |
| 29. | San Antonio | TX | 1,033 | 1,382 |
| 30. | Indianapolis | IN | 1,158 | 1,311 |
| 31. | New Orleans | LA | 1,206 | 1,257 |
| 32. | Charlotte | NC | 912 | 1,233 |
| 33. | Hartford | CT | 1,051 | 1,119 |
| 34. | Orlando | FL | 619 | 1,166 |
| 35. | Salt Lake City | UT | 824 | 1,154 |
| 36. | Rochester | NY | 968 | 1,028 |
| 37. | Nashville | TN | 782 | 1,044 |

# TABLE 3-1 (continued)

| Rank | *Name and Designation** | *State* | Population 1978 | Population 1993 |
|---|---|---|---|---|
| | | | | |
| 38. | Memphis | TN | 884 | 1,016 |
| 39. | Buffalo | NY | 1,063 | 970 |
| 40. | Oklahoma City | OK | 804 | 995 |
| 41. | Louisville | KY | 933 | 978 |
| 42. | Dayton | OH | 949 | 958 |
| 43. | Greensboro | NC | 805 | 979 |
| 44. | Providence | RI | 850 | 914 |
| 45. | Jacksonville | FL | 698 | 962 |
| 46. | Albany | NY | 832 | 888 |
| 47. | Richmond | VA | 746 | 913 |
| 48. | W Palm Beach | FL | 496 | 931 |
| 49. | Birmingham | AL | 781 | 864 |
| 50. | Honolulu | HI | 722 | 866 |
| 51. | Austin | TX | 480 | 864 |
| 52. | Fresno | CA | 533 | 822 |
| 53. | Las Vegas | NV | 376 | 878 |
| 54. | Raleigh-Durham | NC | 520 | 808 |
| 55. | Scranton | PA | 713 | 747 |
| 56. | Tulsa | OK | 591 | 738 |
| 57. | Grand Rapids | MI | 584 | 716 |
| 58. | Allentown | PA | 627 | 703 |
| 59. | Tucson | AZ | 461 | 709 |
| 60. | Syracuse | NY | 649 | 671 |
| 61. | Greenville | SC | 536 | 665 |
| 62. | Omaha | NE | 598 | 635 |
| 63. | Toledo | OH | 604 | 613 |
| 64. | Knoxville | TN | 536 | 640 |
| 65. | Springfield | MA | 586 | 597 |
| 66. | El Paso | TX | 445 | 646 |
| 67. | Harrisburg | PA | 536 | 605 |
| 68. | Bakersfield | CA | 370 | 599 |
| 69. | Little Rock | AR | 448 | 532 |
| 70. | Charleston | SC | 392 | 525 |
| 71. | Youngstown | OH | 542 | 494 |
| 72. | Stockton | CA | 314 | 510 |
| 73. | Albuquerque | NM | 381 | 506 |
| 74. | Wichita | KS | 397 | 473 |
| 75. | Sarasota | FL | 319 | 504 |

* CMSA indicates the metropolitan area is a Consolidated Metropolitan Statistical Area, consisting of 2 or more adjacent Primary Metropolitan Statistical Areas.

^ Many of these MSAs cross state boundaries. This table lists the state in which the central city of the MSA is located.

The outcome variable is the growth in HMO market share over a 5-year period in percentage points; this outcome is measured for both 5-year periods under study.

The use of growth in market share as the outcome variable assumes that such growth is independent of the initial level of HMO market share. Mathematically, it is equivalent to using a coefficient of 1.0 for the HMO market share of the earlier years (1973, 1988) in estimating the HMO market share of the later years (1978, 1993). The advantage of this simplifying assumption is that it avoids pre-occupation with determining the "correct" or "natural" relationship between HMO market shares of different years.[56] This approach facilitates a more detailed examination of other candidate factors behind HMO growth.

Two supplementary analyses performed after the final models for both periods were chosen supported the assumption of a coefficient of 1.0 for the prior values of HMO market share.[57]

A2 EXPLANATORY VARIABLES AND ANALYTIC METHOD

Twenty-five variables were tested as possible explanatory variables, or predictors, of the outcome variable. These include variables pertaining to the supply of medical resources, other medical system characteristics and general economic and demographic variables. They are listed in Table 3-2.

The statistical method of this study is ordinary least squares (OLS) multiple regression. The data satisfy the requirements necessary to apply this method and establish structural relationships. Residual values are examined and analyzed to assure satisfactory compliance with statistical assumptions.

## B. Methods Issues

There are 4 methods issues of particular significance to this study. The first 3 concern threats to the validity of the regression results. The 4th concerns the statement of hypotheses.

B1 OMITTED VARIABLES

The goal of a structural statistical model is to give a complete explanation of the outcome under study. [58] All the factors that jointly determine the measured outcome should be

---

[56] The natural growth path of HMO enrollment in cities, or for that matter in the U.S., over time is a legitimate and serious issue worthy of careful investigation. Further reference is made to this issue in Chapter 5, Conclusions. However, statistically determining such a path is not the primary purpose of this study.

[57] The supplemental analyses involved using the prior value of HMO market share and the 4 variables used in each final model to estimate HMO market share for each of the later years (1978, 1993). In these 2 supplemental regressions there were no constraints on the coefficients of the prior year values. In both cases, the regression algorithm assigned a coefficient within 2% of 1.0 (i.e. between .98 and 1.02) to the prior year market share. Similarly, the coefficients of the other variables were very similar to the coefficients assigned by the final models for the 2 periods. The results of these supplemental analyses lend support to the implicit assumption of a 1.0 coefficient for the 1973 and 1988 HMO market share values.

[58] Originally in econometric theory, structural models specified supply and demand equations and solved for Quantity (Q) and Price (P) by setting supply equal to demand. However, it is now frequent practice in the social sciences to specify a structural reduced form equation for the phenomenon under study (usually some form of Q, as in this project) without the specification of separate supply and demand equations.

*TABLE 3-2*

*EXPLANATORY VARIABLES BY CATEGORY*

| # | *VARIABLE* | DESCRIPTION | REASON FOR SELECTION |
|---|---|---|---|
| | | | |
| | ***Category A:*** | MEDICAL SUPPLY | |
| 1 | Hospital Beds per capita | Only General Hospital Beds | Promising Results in Prior Studies |
| 2 | MDs per capita | Excludes Osteopaths | Major Component of Study |
| 3 | RNs per capita | Registered Nurses | May Reflect Prevailing Institutional Practices |
| 4 | LPNs per capita | Licensed Practical Nurses | May Reflect Prevailing Institutional Practices |
| 5 | Pharmacists per capita | Active Registered Pharmacists | Speculation |
| | ***Category B:*** | ***Other Medical System Measures*** | |
| 6 | Hospital Days per capita | Only General Hospital Beds | Major Component of Supply |
| 7 | Hospital Expenditures per capita | Gen and Spec Hosps combined for 1970s, just Gen Hosps for 1990s | Best Available Measure of Level of Health Care Expenditures in MSAs |
| 8 | Hospital Costs per day | See Appendix A | Best Available Approximation of the MSA Relative Price of Health Care |
| 9 | Percent of MDs who are AMA Members | Measured on the State level in 1971, not available for 1990s | AMA and State Medical Societies Opposed HMOs for Many Years |
| 10 | Percent of MDs Aged 45-64 | Self explanatory | Older Physicians Believed Less Receptive to HMOs |
| 11 | Proportion of FPs | Includes both Family and General Practitioners, not in 1970s analysis | HMOs may want FPs to serve as Gatekeepers |
| 12 | Percent of Physicians in Group Practice | State level Variable | Group Practice Physicians Believed More Open to HMO Supervision |
| 13 | Blue Cross/Blue Shield Market Share | See Table 3-3, not available for 1990s | BC/BS was the Dominant Insurer in many MSAs |
| 14 | Age of Oldest HMO | Measures Continuous Exposure to Operational HMOs | HMO Enrollment seemed to Grow Naturally once the 1st HMO went into Operation |

***Table is continued on following page.***

*TABLE 3-2 (continued)*

*EXPLANATORY VARIABLES BY CATEGORY*

| # | *VARIABLE* | DESCRIPTION | REASON FOR SELECTION |
|---|---|---|---|
| | | | |
| | ***Category C:*** | GENERAL ECONOMY | |
| 15 | Per Capita Income | Adjusted for Metropolitan Cost of Living (COLA) | Promising Results in Prior Studies |
| 16 | Economic Growth | Growth in per capita Income over 15 year period, not include in 1970s Analysis | Income Growth a good measure of Overall Economic Environment |
| 17 | Employees per Establishment | Estimated based on size categories (1-4, 5-10, etc.) | Employers Chose Health Plans for Most People |
| 18 | Percent of Workers who are Union Members | Self explanatory | Some early HMOs had Strong Union Links |
| | ***Category D:*** | DEMOGRAPHIC | |
| 19 | Population Density | Self explanatory | Could affect several Vs that Influence Provider, Employer or Consumer Choice |
| 20 | Population Growth | Over a 23 year period, not included in 1970s analysis | Measures Overall Demographic Change |
| 21 | Net Migration | Net Migration as a percent of MSA Pop, see Table 3-3 | Promising Results in Prior Studies |
| 22 | Average Schooling | Estimate of MSA Population Avg # of Years of Schooling, see Appendix A | Promising Result in 1 Prior Study |
| 23 | Regional Dummies* | Based on Official Census Divisions as of 1988 | Regional Cultural Differences may have influenced HMO Growth |
| 24 | Relative Latitude | Position along North-South Axis | Accurate Measure of Geographic Position |
| 25 | Relative Longitude | Position along East-West Axis, Honolulu "moved" East to reduce Influence | Accurate Measure of Geographic Position |

* Regional Dummies reflect the New England, Mid Atlantic, South Atlantic, E North Central, W North Central, South Central, Mountain and Pacific

accurately measured by the explanatory variables in the model equation. If the model is absolutely structural, all instances of the observed outcome are determined just as the model "predicted value" is determined by the model equation, with only a stochastic error term accounting for small differences between the observation and the "prediction".

However, in the case of HMO enrollment growth at the MSA level, we do not know the complete set of influential factors. This is partly because the number of factors that might influence HMO growth is very large and the previous published research on the subject is limited. It is also because some very likely influential factors, such as the reputations of individual HMOs with their current enrollees, are very difficult to measure accurately and comprehensively. In the case of other factors, such as premiums charged by HMOs and other health insurers, measurement may have been possible and measurements may have even been taken, but the data are not currently available.

Therefore this study confronts the likelihood that 1 or more structural variables are not included in the analyses. This is known as an Omitted Variable problem. Not only does this problem prevent the analysis from being complete, but the omission of important variables may bias the estimated influence of one or more of the variables found to be influential on the observed outcomes.

Fortunately, it is possible to conduct a valid analysis with omitted variables as long as the potential influence of the omitted variables is considered and analyzed. 4 questions are critical to the consideration of each omitted variable:

* Would it be likely to influence the study outcome if it were included?
* Is there a clear direction in which the effect most likely runs?
* Is the influential omitted variable likely to be highly correlated with one or more variables shown to be influential? If there were such a correlation, then the model results would be biased.
* If the answers to the first 3 questions are all affirmative, then what is the direction of the correlation and what is the corresponding direction of the bias on the variables included in the final model?

Besides the factors represented by the explanatory variables in Table 3-2, this study has identified 6 factors that may influence HMO growth at the MSA level. These are:

a) State Regulations
b) Prevalent Model Type of HMO
c) Premium and Out of Pocket Costs
d) Labor Market Effects
e) Insurance Market Effects
f) Reputation of Individual HMOs and non-HMO Plans

These potential factors can be related to the 4 categories of factors discussed in Chapter 1. These 4 categories are A) Market potential, B) Extent of public exposure to the innovation, C) Characteristics of individual HMOs, and D) The role of other institutions. Hypothesized factors a, d and e relate to category A) Market potential, while hypothesized factors b, c and f relate primarily to category C), with the understanding that characteristics of individual HMOs need to be compared with parallel characteristics for non-HMO health insurance plans for those characteristics to be useful in the analysis of overall HMO growth at the MSA level.

a) *State Regulations*

Prior analyses have indicated that state regulations had little effect on HMO growth in the 1970s.[59] These regulations underwent little change between the 1970s and 1993, when the 2nd period of this study ends. Therefore it is unlikely that state regulations would have strongly influenced the results of this analysis.[60]

*b) Prevalent Model Type of HMO*

Model type, is discussed in Chapter 1. Perhaps HMOs of one model type were prone to grow faster than HMOs of other model types. If so, prevalent model type might account for much of differential enrollment growth across MSAs. In the 1970s, the Independent Practice Association (IPA) model was considered friendlier to physicians than the Group model, and prevailing model type may have been correlated with 1 or more physician related variables. This is a serious threat to the validity of this study. Further research on this possible effect is recommended in Chapter 5, Conclusion.

*c) Premium and Out of Pocket Costs*

This is discussed in Chapter 2. There is substantial evidence that HMOs have offered their subscribers lower premium and out of pocket costs than other health insurance plans from 1958 to the present. It would be desirable to use data measuring HMO cost advantage by MSA, but accurate data on this dimension are not available.[61] Such data by MSA, if available, might be highly correlated with hospital costs.[62] Therefore the inclusion of 1 or more cost advantage measures might reduce the magnitude of any hospital cost effect found. There is little evidence that HMO cost advantage would be substantially correlated with any of the other explanatory variables used here.

*d) Labor Market Effects*

Since health insurance is mostly purchased by employers, conditions or changes in an MSA's labor market could easily influence HMO enrollment in that city. Two attributes of a labor market, the extent of unionization and the average size of work establishment are measured and analyzed here. Another attribute, labor skill level, is believed to be highly correlated with average income and education levels, both of which are also used in this analysis.

Another key labor market attribute is the extent to which health insurance is provided with employment. But it is possible to make arguments both ways; i.e. high rates of employer-

---

[59] Please see Chapter 2, Literature Review, Section D.

[60] Unlikely, but not impossible. Changing conditions may have made state regulations more influential even as the regulations themselves remained unchanged. But the academic and journalistic literature emphasizes the effect of other factors on HMO growth and other trends during the 1973 to 1993 period.

[61] Some work on HMO premiums in most states has been done Wholey et al 1995), but data limitations of state insurance reports and the complexity of health expenditures would make any comparison of costs between HMOs and other insurers on the MSA level a major project in itself.

[62] Luft (1978) found that HMOs achieved much of their cost advantage from reduced hospitalization rates.

based health insurance may increase or decrease HMO market share.[63] Extent of employer-based health insurance may well be positively correlated with average income, but the extent of the correlation on the MSA level is unknown. If income showed a strong effect on HMO market share growth, it would be desirable to control for this omitted variable.

*e) Insurance Market Effects*

One aspect of insurance markets, the influence of state regulations is included with the 1st category discussed above. Another attribute of metropolitan health insurance markets, the market share of Blue Cross/Blue Shield (BC/BS) insurers, is measured and analyzed for the 1970s period.[64] Another possibly important attribute is the extent to which 1 or a few sellers control a health insurance market (sometimes referred to as market structure).

At least for the early period of HMO growth, it would be natural to hypothesize that markets with many competing insurers would be more open to "upstart" HMOs, while markets mostly controlled by 1 or a few established insurers would see greater resistance to the HMO movement. Since BC/BS insurers were major players in many health insurance markets, we would expect a positive correlation between BC/BS market share and overall market share concentration. Therefore, the omission of a measure of market power from the analysis may potentially bias the coefficient of BC/BS influence upward. Otherwise, there is no known evidence, and little reason to believe, that health insurance market structure would be highly correlated with any of the variables tested here.

f) *Reputation of Individual HMOs and non-HMO Plans*

HMO market share growth at the MSA level may well be influenced by the reputation of individual HMOs or non-HMO plans with the public at large, employers, providers or other groups. The reputation factor is intertwined with the labor market and insurance market effects because these factors dilute and delay the direct effect of reputation on market share.[65]

Reputation of an individual plan may also be affected, for better or worse, by the length of time that plan has been in operation. For HMOs, the age of individual plans will be correlated with the Age of Oldest HMO variable already included in this analysis, and therefore that variable would help control for reputation effects. For non-HMO plans, data on length of time in operation are not included in this study and is unlikely to be highly correlated with the variables that are.

B2 ENDOGENEITY

For almost any statistical model, it is highly desirable that the explanatory variables are exogenous; they must not be influenced by the outcome variable. However, very often such causal relationships run both ways, and many of the variables that can be plausibly hypothesized to influence HMO growth can equally plausibly be hypothesized to be influenced by the magnitude of HMO enrollment.

---

[63] Would increase market share: If low wage employers were expected to offer health insurance, they would try to offer the cheapest insurance possible and they would turn to HMOs. Would decrease market share: If the prevailing economic climate dictated that employers offered health insurance, then it might well also dictate what type of insurance they offered.

[64] Comparable data are not available for the 1988-93 period.

[65] In some industries, reputation may rapidly influence market share, and the 2 variables become virtually synonymous. Consumer surveys suggest that this is not the case with health insurance.

A model with endogenous variables cannot be structural because the endogeneity will bias the estimates of the variable coefficients; that is, unrecognized endogeneity will distort the magnitude, and possibly the direction, of the structural effect inferred from the statistical analysis.[66] One method for addressing endogeneity is the use of an instrumental variable. If the instrumental variable is highly correlated with the structural component of the hypothesized explanatory variable, but not at all correlated with or influenced by the outcome variable, then an analysis using the instrumental variable will produce a less biased estimate of the structural relationship.

One favored way of generating an instrumental variable is to regress the suspected endogenous explanatory variable on a set of known exogenous variables. Frequently, the endogenous variable is regressed on all the variables in the model that are believed to be exogenous. The "predicted" values of this explanatory variable constitute the best possible instrumental variable in the sense that it must be as highly correlated as it can be and still be an exogenous variable. This approach is known as Two-Stage Least Squares (2SLS, Kennedy 1992).[67]

One problem with the 2SLS approach is that it introduces measurement error. The instrumental variable generated by the first stage is not an accurate measurement of the structural variable but an imperfect statistical approximation (Farley 1993, 88). The 2nd problem with 2SLS is that, while disposing of the assumption that a particular explanatory variable is exogenous, it introduces substitute assumptions that may be just as questionable as the disposed assumption. In particular, it is assumed that the use of the 1st stage regression does not bias the results of the 2nd stage regression. If the variables used to construct the instrumental variable are structural to the outcome variable in their own right, rather than through the explanatory variable, then the coefficients yielded by the 2nd stage equation are likely to be biased.

If it is necessary to construct instrumental variables for several explanatory variables, then the aggregate loss of accuracy may be considerable. Additionally, the issue of endogeneity may become intractable, and the likelihood that the results will have external validity may go down. The 2SLS approach is more likely to be useful when only 1 explanatory variable is suspected of being endogenous.

The data collected for this study provide a special and unusual opportunity to avoid endogeneity. Structural relationships are generally believed to assert themselves over a period of time (Holland 1986). Under this assumption, an event cannot be influenced by an event that takes place subsequently;[68] a variable can only be endogenous to events that took place

---

[66] The simplest case consists of 2 phenomena that positively reinforce each other, such as album sales and concert attendance for a musical act. If the causal effect were hypothesized to run solely from album sales to concert attendance and a simple regression performed, then the results would be misinterpreted, and the estimate of the effect of album sales on concert attendance would be biased upward. However, with multivariate analyses with a more complex set of causal relationships, it is harder to determine the nature of a biasing effect from an unsound causal assumption.

[67] However, the use of the word "best" may be misleading, inasmuch as there may be omitted variables that either would make a better instrumental variable by themselves or should be included in the regression equation to construct a synthetic instrumental variable.

[68] However, an event can be influenced by the expectation of another event, such as when people unpack winter clothes on a hot day in September. The Rational Expectations school of macro-economics is notable for its reliance on the assumption that

before it was measured. But variable values may be influenced by a temporally long string of events. Causal effects may be felt with very long lags, and it is often very difficult to determine the length of the lags and the relative importance of events with different lags.[69]

Given a complex and unclear set of causal relationships among a group of variables, it is difficult to say which variable values at which times are likely to be endogenous to which other variable values at other times, either earlier or later. However, it is much less likely that the values for a particular variable are endogenous to subsequent changes in another variable. Unless there are good reasons to believe otherwise, this is true even if static values of the 1st variable are endogenous to simultaneous static values of the 2nd variable.

Therefore this study regresses the growth of HMO market share over two 5-year periods on prior values of certain explanatory variables, specifically those variables that might otherwise be endogenous. This report shall refer to this method as Growth Prediction method because prior values of these explanatory variables are used to predict the amount of growth of the Outcome variable over a subsequent period.

The Growth Prediction method can be expressed schematically as follows:

$$dX = f(A1, A2, A3, \ldots AN, B1, B2, B3, \ldots BM)$$

where: X = HMO Market Share
dX = Change in HMO Market Share

A1, A2, A3, ... AN = Explanatory Variables Measured at the Beginning of the Change Period
B1, B2, B3, ... BM = Explanatory Variables Measured at the End of the Change Period

The A variables are measured at the beginning of the growth period to eliminate any endogenous effect the outcome variable would have on them. In general, these tend to be medical supply variables and other medical system measures. The B values, in line with standard methods, are measured contemporarily with the outcome variable, i.e. at the end of the growth period. B variables tend to reflect general economic and demographic factors.

The prior values of explanatory variables are likely to be exogenous to subsequent changes in the outcome variable whether the changes are measured over a period of 1 day or 100 years. In selecting the length of the period for which change in the outcome variable is measured, the challenge is to determine the period of time for which the structural effect of the explanatory

---

much financial behavior is based on certain rational and understandable expectations concerning aggregate economic indicators.

But it would be going far beyond the assumptions of Rational Expectations theorists to believe, for example, that the location decisions of MDs are substantially influenced by correct anticipation of local HMO growth rates, particularly if HMO growth is not the dominant factor in determining M.D. compensation, working conditions and social standing.

[69] For example, the population density of New York City may be influenced by its natural topography, by actions of John Jacob Astor in the early 1800s and by recent trends in crime prevention. If the first 2 factors are dominant, and if population density determines land prices, then New York land prices in 1900 could be endogenous to population density in 2000! (However, presumably the statistical relationship with population density in 2000 would be weaker than that with population density in 1900.)

variable is maximized. Unfortunately, this period may be different for different variables and for different starting points.

Changes over periods that are very short (measured in days or weeks) are more likely to reflect random shocks rather than structural processes. On the other hand, the causal effect of an explanatory variable at a fixed time will eventually fade away. Normally in the social sciences, we assume that the effect on many outcome variables is unlikely to last as long as a decade.[70]

Based on intuitive judgment and data availability considerations, a change period of 5 years was selected. There is no empirical evidence that 5 years is necessarily the best interval for this purpose. But if 5 years is too long a period, that would only weaken the demonstrated effect of 1 or more explanatory variables.

As shown in Table 3-3, health sector explanatory variables include measures of the supply of various health professionals, measures of hospital costs and specific attributes of MSAs' MD populations.[71] Therefore, this regression analysis uses values of these variables measured at or near the beginning of the growth period. Some of the variables were measured 1 or 2 years into the growth period. If the variables that were measured later are strongly and rapidly interactive with HMO growth, then these measurements could be endogenous. However, in the one case where regression results indicated that endogeneity is a significant threat, testing with earlier values for the variable still showed a statistically significant effect (see Chapter 4, Subsection B4).

On the other hand, general economic and demographic variables are not suspected of being endogenous to HMO enrollment. While many HMOs certainly qualified as large corporations by the early 1990s, they only collectively controlled 3% or less of the economic product of any MSA. Therefore it is implausible that HMO Market Share would have a substantial effect over economic or demographic variables such as Per Capita Income or Population Density. These variables are usually measured toward the end of the growth period.

In summary, endogeneity, or mutual causality, is a serious threat to the validity of this statistical analysis of HMO enrollment growth. One common method for eliminating or reducing endogeneity is 2SLS. However, 2SLS suffers from measurement error and the necessity of making unsubstantiated assumptions. Therefore the Growth Prediction method, which uses subsequent changes in HMO growth as the outcome variable, is used to test for structural effects of many explanatory variables.

With the assumptions that causal effects do not run backwards over time and that explanatory variables were not determined by rational anticipation of future HMO enrollment growth, the Growth Prediction method provides a valid means of testing for structural effects.

---

[70] This is why most studies use simultaneous values of outcome and explanatory variables and it is very rare for values lagged by 10 years to be used.

[71] Under the concept that a cause must precede an effect, the Age of the Oldest HMO in an MSA cannot be endogenous to current HMO enrollment.

*TABLE 3-3*

*SOURCE INFORMATION ON EXPLANATORY VARIABLES*

*Please see Key to Abbreviations at end of Table*

| # | VARIABLE | *SOURCE* | ENDOGENEITY ISSUE? | *YEARS MEASURED* | | GEOGRAPHIC UNIT |
|---|---|---|---|---|---|---|
| | ***Category A:*** | | ***Medical Supply*** | | | |
| 1 | Hospital Beds per capita | ARF | Yes | 1973 | 1989 | MSA |
| 2 | MDs per capita | ARF | Yes | 1973 | 1989 | MSA |
| 3 | RNs per capita | ARF | Yes | 1972 | 1990 | MSA |
| 4 | LPNs per capita | ARF | Yes | 1974 | 1990 | MSA |
| 5 | Pharmacists per capita | ARF | Yes | 1974 | 1990 | MSA |
| | ***Category B:*** | | ***Other Medical System Measures*** | | | |
| 6 | Hospital Days per capita | ARF | Yes | 1973 | 1989 | MSA |
| 7 | Hospital Expenditures per capita | ARF | Yes | 1975 | 1989 | MSA |
| 8 | Hospital Costs per day | ARF | Yes | 1973/75 | 1989/90 | MSA |
| 9 | % of MDs who are AMA Members | AMA | Yes | 1971 | N/A | State |
| 10 | % of MDs Aged 45-64 | ARF | Yes | 1975 | 1989 | MSA |
| 11 | Proportion of FPs | ARF | Yes | N/A | 1989/90 | MSA |
| 12 | % of Physicians in Group Practice | AMA | Yes | 1975 | 1988 | State |
| 13 | Blue Cross/Blue Shield Market Share | BC/BS | Yes | 1973 | N/A | Usually State* |
| 14 | Age of Oldest HMO | Inter-Study | No | 1978 | 1992 | MSA |
| | CATEGORY C: | | *General Economy* | | | |
| 15 | Per Capita Income | ARF | No | 1978 | 1993 | MSA |
| 16 | Economic Growth | ARF | No | N/A | 1978-93 | MSA |
| 17 | Employees per Establishment | CBP | No | 1979 | 1993 | MSA |
| 18 | % Workers in Unions | CPS | No | 1976 | 1994 | State |

Table is continued on following page.

*TABLE 3-3 (continued)*

**SOURCE INFORMATION ON EXPLANATORY VARIABLES**

| # | VARIABLE | *SOURCE* | ENDOGENEITY ISSUE? | *YEARS MEASURED* | GEOGRAPHIC UNIT |
|---|---|---|---|---|---|
| | | | | | |
| | ***Category D: Demographic*** | | | | |
| 19 | Population Density | ARF | No | 1975 1993 | MSA |
| 20 | Population Growth | ARF | No | N/A 1970-93 | MSA |
| 21 | Net Migration | Census | No | 1970-77 1991 | MSA |
| 22 | Average Schooling | ARF & Census | No | 1970 1990 | MSA |
| 23 | Regional Dummies$ | Census | No | DNA | MSA |
| 24 | Relative Latitude | ARF | No | DNA | MSA |
| 25 | Relative Longitude | ARF | No | DNA | MSA |

Key to Abbreviations:
ARF – Area Resource File
AMA – American Medical Association
BC/BS – Blue Cross and Blue Shield Association
CBP – County Business Patterns
CPS – Current Population Survey (US Census)
N/A – Not Available
DNA – Does Not Apply
MSA – Metropolitan Statistical Area

Notes:
* In 1977 Blue Cross enrollment was divided between 2 or more BC/BS organizations in 9 states. Usually, these intra-state plans each exclusively served a geographic region within their state.
$ Regional Dummies reflect the New England, Mid Atlantic, South Atlantic, E North Central, W North Central, South Central, Mountain and Pacific Regions.

B3 LIMITATIONS OF 1970s DATA SET

Since this study is concerned with the growth of HMO enrollment in metropolitan areas, it would be desirable if growth in all cities were comparable in nature but variable in extent. In other words, if the only outcome that varied across cities was the extent of HMO growth, then that would simplify the application of analytic techniques. However, during the 1970s, many cities had no operational HMOs and hence no HMO enrollment. In order for HMO enrollment to grow, one HMO had to commence operations. Such operations were initiated in 19 of the nation's 75 largest cities between 1973 and 1978. Another 28 MSAs had no HMO enrollment in 1973 or 1978.[72]

This particular set of circumstances raises 2 problems for the 1970s analysis. One problem is that the 28 cities with no HMO enrollment in either year had an outcome value of zero. When a large percentage of observations have outcome values of zero, this is a serious violation of the normality assumption, and OLS estimates are biased in such cases (this is known as a limited dependent variable). In this particular study, cities with no HMO enrollment throughout the period may not be comparable with cities that did have enrollment; and factors leading to the establishment of an MSA's 1st operational HMO may be different from factors determining the overall growth of enrollment once that HMO gets rolling. Therefore these 28 observations were excluded from the analysis that was used to develop the final 1970s model.

The second problem concerns the 19 cities in which HMO operations were initiated between 1973 and 1978. As we have seen, there is no good reason to assume that the factors that led to the establishment of an operational HMO in a city were exactly identical to the factors that contributed to rapid growth once the first HMO was established. In fact, the literature suggests otherwise (Welch 1984). Therefore, it would be ideal to analyze establishment and growth following establishment separately.[73] However, because of the small sample of cities for which data was developed, it was decided to include the 19 cities with new HMO operations in order to boost the sample size for the analysis.

Supplemental analyses were performed to assess the effects of excluding the 28 cities with no HMO enrollment in either year and the effects of including the 19 cities in which HMO operations initiated. The results of these analyses are discussed in Chapter 4, and the specific numerical results are presented in Appendix H.

The final issue that arose with the 1970s data set was the outlier status of Stockton CA. It had a change in HMO market share of -14.8%, while the other 46 values ranged from -2.6% to 7.3%. Clearly, Stockton would have an enormous influence on the analysis results if included.

However, Stockton's outlier value stemmed from a definition problem. The HMO that enrolled over 15% of Stockton's population in 1973, the San Joaquin Foundation for Medical Care (SJF), was not a true HMO by the standards of that time. It was an "imitation" HMO organized by the San Joaquin County Medical Society for the purpose of keeping Kaiser

---

[72] By 1988, there were operational HMOs in 73 of these cities. Therefore the limited data problem described in this subsection does not seriously affect the 1988-93 analysis.

[73] Once separate models for establishment and for post-establishment growth were created and inspected, then there would be an opportunity to integrate these models into a comprehensive model of HMO enrollment.

Permanente from moving into this MSA.[74] From 1973 to 1978, SJF shrank drastically, reorganized and changed its name. This is why the data (falsely) show a decline in HMO enrollment of 14.8% of metropolitan Stockton's population.[75] Therefore, this conspicuous outlier was eliminated. This left 46 observations on which the 1970s analysis was conducted.

B4 MEASUREMENT ERROR

Measurement error in either the outcome or explanatory variables is a potential threat to the validity and accuracy of the relationships that are found in this study. The primary concern is that systematic measurement error will bias the study results, erroneously creating the impression of strong statistical relationships. However, random measurement error is also a concern because it has the potential to lower coefficients and t-statistics below their true values.

The measurement of the primary outcome variable, change in HMO market share, is described in Section C of this chapter, and further detail is provided in Appendix A. Available evidence indicates that these data are generally accurate, and that any errors are random and small relative to the variability of this variable for the 1973-78 and 1988-93 periods.

The measurement of the explanatory variables is also documented in Section C and Appendix A. In general, these data come from well established sources. The available evidence supports the accuracy of such variables as RNs per capita, Economic Growth and many others. The explanatory variables for which there is concern of substantial measurement error are discussed in Appendix A. These are the hospital variables, Average Years of Schooling and Establishment Size.[76]

B5 FRAMING OF HYPOTHESES

Subject to some basic assumptions, standard regression methodology automatically tests one or more hypotheses each time a regression is run (Kennedy 1992, 43-44). The regression results table provides the t and P statistics that help determine whether the association between the outcome variable and each explanatory variable is statistically significant under the frequentist hypothesis testing statistical paradigm.

However, the interpretation of statistical results requires additional analytic thinking. Do the hypotheses that are statistically verified or rejected correspond to the research hypotheses that are most critical to understanding and predicting the phenomenon under study? Do they correspond to the hypotheses that are most useful to policy making? And, for multiple

---

[74] For an account of the beginnings of SJF, please see Can Physicians Manage the Quality and Costs of Health Care? by John G. Smillie, 1991, p. 95.

[75] InterStudy data show 7 other HMO foundations operating as of December 1973, including 5 in the top 75 MSAs. The entire HMO enrollment in Las Vegas was in another foundation, Nevada Health Plans, which went out of business in 1974. Doug Wholey doesn't consider any of these foundations to have been legitimate HMOs (personal communication from Rich Hamer of InterStudy). However, available evidence concerning the circumstances of the other, smaller, Foundations was less clear.

[76] As it turned out, none of these potentially inaccurate variables showed a sufficiently strong relationship with HMO growth to be included in either of the final models. Therefore the concern about systematic measurement error engendering a false impression of a statistical relationship appears to be moot. The greatest measurement error-related concern is possible confounding of Establishment Size with Latitude. This is discussed in Chapter 4, sub-section B6, Latitude in the Final 1970s Model.

regressions, are all the variables and their corresponding hypotheses equally important, or is there a subset of variables that reflect the most critical hypotheses?

If there is consensus that the outcome variable is worth investigating, then the effort to develop a useful model largely corresponds to matching statistical hypotheses with critical research hypotheses. In policy analysis, we seek to go 1 step further and match research findings with policy issues and alternatives; this will be addressed in Chapter 5. This chapter section addresses the question of prioritizing multiple hypotheses and of seeking to generate the highest possible level of knowledge and insight from the verification or rejection of these statistical hypotheses.[77]

Under the classical scientific method, a study is designed to verify or reject 1 hypothesis. Or it is designed to resolve the choice between 2 contrasting hypotheses, verifying 1 and rejecting the other.[78] However, the tools of multiple regression and modern computing make it possible to test several or more statistical hypotheses simultaneously. Given the vastness and complexity of social phenomena, studies designed to painstakingly test 1 and only 1 hypothesis may be a luxury. Practical experience teaches that such studies are likely to be disappointing - i.e. it is more likely that the specific hypothesis will be rejected than that it will be verified.[79]

Therefore this study, from the outset, considered multiple factors that may have helped or hindered HMO growth at the MSA level. Since the few prior studies generated inconclusive and sometimes mutually inconsistent results, the field was open to a very wide range of possible explanatory variables and matching hypotheses.

However, a "dustbowl empirical" approach of simply testing a large number of explanatory variables held limited promise for definitively explaining differential HMO market share for 2 reasons.[80] First, if enough statistical tests are performed, inevitably some explanatory variable will pass conventional tests of statistical significance. Although corresponding statistical adjustment can be attempted, seemingly arbitrary changes in the regression program can determine whether the results achieve statistical significance.[81]

---

[77] Popper (1959) argued that hypotheses cannot be proved per se, only disproved. In Popper's view, if a hypothesis is not disproved by a sufficiently rigorous set of experiments (or perhaps empirical studies) designed to test its validity, than that is as close to proof as is possible. However, in this study, the goal is simply to use regression analysis to provide meaningful evidence in favor of, or in opposition to, specific hypotheses.

[78] Platt (1964) argues that scientists' obligation is to identify and conduct the crucial experiment that will exclude 1 or more plausible explanations for a phenomenon. But note skepticism over whether this physical science approach can be applied to the social sciences. Babbie (1991, 81) states "The 'critical experiment' that ultimately determines the fate of an entire theory is rare indeed."

[79] Campbell and Stanley (1963, p.3) argue that this plodding, disappointment-laden approach is characteristic of a true science and is precisely what is necessary for social science to advance. "We must instill in our students the expectation of tedium and disappointment and the duty of thorough persistence, by now so well achieved in the biological and physical sciences. We must expand our students' vow of poverty to include not only the willingness to accept poverty of finances, but also a poverty of experimental results."

[80] A 3rd limitation of such an approach, endogenous explanatory Vs, is discussed and resolved for the purposes of this study earlier in this chapter.

[81] One way of adjusting for the performance of multiple statistical tests is to use the Bonferroni method of multiple comparisons, but this method is very conservative and may lead to false negative findings concerning statistical significance for many analyses.

Second, almost any result can be plausibly justified post hoc. But the mark of successful research is that a study result can be predicted and explained before the study is conducted. However, even if this standard is not met, an a priori statement of specific expectations and their relative importance is still useful to the advancement of knowledge. The process of analysis and explanation, both before and after any unexpected results are produced, will be more authentic than simple post hoc justification.

Before the 1970s regression runs, 4 primary hypotheses were specified. Beds per capita, MDs per capita and Market Share of BC/BS insurers were expected to show a positive effect on HMO market share, and Income per capita was expected to show a negative effect.

The beds and MDs per capita hypotheses were based on the reasoning that a relative surplus of resources would lead the owners of those resources to contract with HMOs; in those MSAs with little or no surplus, resource owners (specifically hospitals and doctors) would have little incentive to try the risky and unpopular HMO experiment. The BC/BS hypothesis was based on anecdotal evidence about BC/Bs executives in most states. Apparently they had accepted the HMO concept by the early 1970s, and they were working in various ways to establish HMOs and help them grow (Goldberg and Greenberg 1977).

The Income per capita hypothesis stemmed from the fact that HMOs were a less expensive form of health insurance. At least on the individual level, we would expect lower income individuals to be more sensitive to insurance premiums in selecting an insurer.[82] Expectations were stated for 16 other variables, although several of these were expected to show no effect.

Before the 1990s regression runs, primary hypotheses were specified that Employees per Establishment and Population Density would have positive effects on HMO market share and that Economic Growth and Population Growth/Net Migration would have negative effects.[83] The 1990s primary hypotheses were different both from the initial 1970s primary hypotheses and from the results of the 1970s analysis. These divergent primary hypotheses reflected the belief that HMO growth was driven by general economic and demographic variables in the late 1980s and early 1990s.

Specifically, the hypothesis concerning employees per establishment responded to the HMO "bust" of the late 1980s. Many HMOs that marketed aggressively to small firms had gone bankrupt or had to cut back their operations drastically, and, as a result, caution in marketing to small firms seemed to prevail well into the 1990s.

The hypotheses concerning economic growth and population growth were also partly based on the influence of the bust. The rapidly growing areas, mostly in the western US, where HMOs had most prospered in the early 1980s tended to include the MSAs most affected by the bust. From a longer run perspective, it could be argued that HMO market share in rapidly

---

[82] The issue of the behavior of employers and other purchasers, and the complexities of applying a principle of individual behavior to large MSAs make this hypothesis speculative. But the advantage of empirical testing is that it can sometimes cut through logical and operational complexities to support or oppose a hypothesis based on a simple conceptual model.

[83] Population Growth and Net Migration show a correlation of .75 in the 1990s data set, so it is reasonable to lump them together in stating hypotheses.

growing MSAs in the West had plateaued and that more stable population centers were actually more promising terrain for HMO marketers by the 1990s.

The 1990s hypothesis concerning population density stemmed from the emerging dominance of IPA model HMOs. The thought was that these loosely knit provider networks were easier to organize and supervise in dense MSAs.

The results of the 2 sets of regressions are discussed in Chapter 4, Findings. How these results compare with the stated primary and other hypotheses is presented in Chapter 5, Conclusion.

## C. Data Sources and Variables

InterStudy Publications has been keeping track of HMO enrollment for 30 years. Their reports for the years 1973, 1978, 1988 and 1993 were the main source for this study's outcome variable. InterStudy has released these reports almost every year since 1973. The InterStudy reports list all the nation's HMOs, the state and MSA in which they were headquartered and their enrollment (usually self-reported). The main problem with this data is that it may not provide the allocation of enrollees across MSAs for HMOs that operated in more than 1 MSA.

The allocation problem was not a serious obstacle to developing accurate estimates of HMO enrollment by MSA for the years 1973 and 1978. In those years, there were relatively few HMOs operating in a smaller number of MSAs, and, except for the Kaiser plans, virtually all HMOs had small enrollments concentrated in 1 MSA.[84] However, for the years 1988 and 1993, when numerous HMOs were larger and more extensive, enrollment allocation was a considerable problem. The allocation process is detailed in Appendix A.

Table 3-3, several pages back, shows all explanatory variables used in the 2 final sets of analysis, along with the sources of those variables. This table also shows which variables may possibly be endogenous to HMO Market Share and the years for which the variable was measured for both analysis periods. In the last column, the table shows what geographic unit the variable was measured for.

Most of the MSA level variables were drawn from the Area Resource File (ARF) maintained by the Bureau of Health Professions of the federal Department of Health and Human Services. This data set has 1 record for each of the counties in the US.[85]

As shown in Table 3-3, 9 variables were not taken from the ARF files for at least 1 of the 2 analysis periods. For a few of these variables, no county or MSA level data were available, so it was necessary to use state level data. These include % of Physicians in Group Practice, % of Workers Belonging to Unions and % of MDs who were AMA members, which Is only available up to 1971. Additionally, % of Population Insured by BC/BS plans, which is only available for the 1970s, was usually calculated on a statewide basis, although it was available on a sub-state level for a few states.

Clearly, using state level data introduced a degree of measurement error. It is difficult to gauge the extent of the error. State level data are probably highly correlated with MSA specific values for most of these variables, but in specific instances the state data were problematic.[86]

---

[84] Lawrence Duffield of Kaiser Permanente Northern California and Bob Pierce of Kaiser Permanente Southern California were good enough to provide me with historical data of these plan's enrollments by County or MSA.

[85] Transforming ARF files into the data sets used in this analysis was a considerable task, but the data itself appeared to be reasonably complete and accurate. Complex logical and definitional problems arose in generating the best possible measurements of hospital related variables, including hospital days per capita, hospital costs per capita, and hospital costs per day.

[86] The greatest problem may lie with MSAs in New York State. Statewide averages, largely driven by values prevailing for the Consolidated New York MSA, for Physicians in Group Practice and Workers Belonging to Unions may have been way off for Rochester or another New York MSA. If so, such MSAs are artifactual outliers with an (inaccurate) disproportional influence on some regression runs.

Please see Appendix A, Data Definition and Measurement Issues, for more detail on the data collection and processing involved in generating measurements of the outcome and explanatory variables.

## D. Model Specification

One critical aspect of model specification is the use of the Growth Prediction method to avoid endogeneity, and this is explained in Sub-section 3Bii. A more technical issue is whether to apply a logarithmic transformation to the outcome variable before analyzing causal factors.[87]

D1 LOG TRANSFORMATION AND OTHER POSSIBLE TRANSFORMATIONS

As discussed in Chapter 1, national HMO enrollment from 1970 to 1997 showed a generally consistent pattern of exponential growth at a rate of 10% per year, and HMO enrollment in many MSAs also demonstrated exponential growth, frequently at an even higher rate, for periods as long as 15 years. Therefore, the likely effects of MSA level exponential enrollment growth on regression results required consideration.

Specifically, if HMO enrollment in all MSAs was subject to exponential growth at the same underlying rate, than those MSAs that had large enrollments at the beginning of the measurement period would show the greatest growth in absolute terms. Those MSAs with lower enrollments would show much less absolute growth. The distribution of absolute enrollment growth would be skewed right and residuals from regression analysis of this outcome would tend toward hetero-skedasticity.[88] This was a concern for both analysis periods, but it may have been more critical for the later period, 1988-93.[89]

A common remedy for a skewed outcome variable and heteroskedastic residuals is log transformation of the outcome variable. This is particularly desirable when the skewness stems from some form of exponential growth because logged outcomes will reflect the underlying rate of growth, which frequently is normally distributed, rather than the absolute result, the distribution of which is frequently highly skewed.

Therefore, taking log transformations of HMO market share values and using growth in logged values as the outcome variable was a serious possibility. Such an outcome variable would have reflected relative, rather than absolute, growth in HMO enrollments. It would have been very similar to casting the growth in pure percentage terms rather than as percentage points of total population. However, there were 2 problems with such an

---

[87] Another option is to use weighted regression, weighting the observations by MSA population. One advantage of weighting by population is that every single HMO enrollee counts equally. If the variability of the explanatory and outcome variables were primarily or largely sampling variability, then weighted regression might be a more appropriate method. However, since this study is working with population data for fairly large cities, there is no reason to believe that sampling variability is this kind of a factor. Additionally, weighting would have complicated the application of regression diagnostics. Weighted Regression is discussed in the Stata Reference Manual, Release 4, 1995, Vol.3, pp. 121-124.

[88] HMO enrollment growth measured in terms of percent of MSA population will show essentially the same distribution as growth in absolute numbers. In fact, HMO market share growth could show an even more skewed distribution than absolute enrollment growth would.

[89] In the earlier period, 1973-78, many cities did not have operational HMOs. The difference between the enrollment of the first few HMO members and the growth of enrollment once an operational HMO is established raises some more basic issues, which are discussed elsewhere in this chapter. However, by 1988, operational HMOs were present in 73 out of 75 cities.

approach. First, since there is no log of zero, it was difficult to generate meaningful change in log of HMO market share for MSAs that started the period with no enrollment.[90]

Second, log transformation of percentages would only be appropriate if MSAs with high HMO market share at the beginning of the growth period experienced greater variance in market share growth in percentage point terms. Inspection and analysis of the data did not bear out this assumption.[91] Therefore growth in percentage points of MSA population was a more appropriate outcome variable.

Other possible transformations could address this kind of specification issue. These include the square root, logit and arcsine square root transformations. For the 1988-93 period, supplemental analyses were undertaken to determine if such transformations of HMO market share would be useful in constructing the outcome variable.

The primary supplemental analysis consisted of a plot of HMO market share in 1993 against HMO market share in 1988. This plot was used to assess whether the relationship between these 2 variables is essentially linear, and how much heteroscedasticity prevails in the relationship between them. The plot clearly indicated that the relationship is essentially linear. The plot indicated a small degree of heteroscedasticity, with more scatter of 1993 values when the 1988 values are high. However, the heteroscedasticity is moderate. This moderate heteroscedasticity is insufficient to preclude the performance of the analysis using the difference between the 1988 and 1993 values as the outcome variable.[92]

D2 REGRESSION PROGRAM

In order to generate the best models, numerous regressions were run and their results were analyzed and compared. Adjusted $R^2$ was used as a metric of goodness of fit, but t statistics for explanatory variables and their corresponding P values were also referred to. The method employed has some similarities to Stepwise Regression. However, the results of each regression were individually assessed, and final models were chosen without the constraint of a mechanical formulation.

First, simple regressions were run with all the candidate explanatory variables. Then numerous regressions with 2 explanatory variables, or double regressions, were performed. Not every

---

[90] It is possible to add an arbitrary fixed number, either in absolute enrollment or as a percent of MSA population, to all HMO market share observations. Such a practice would result in a "loggable" number for every MSA. But, when this was attempted, no choice of arbitrary added number provided for a set of useful and realistic log transformed values.

[91] The reduced variance in market share growth among cities with large enrollments (compared with what was expected) may have been partly due to the somewhat more modest growth in overall HMO enrollment during the 1973-78 and 1988-93 periods. Log transformation might be more appropriate for enrollment growth during 1983-88 or other periods.

[92] As a check, comparable plots of 2 sets of transformed values were generated and inspected. Logit transformed values for 1993 were plotted against logit transformed values for 1988. This plot indicates a non-linear relationship. It also shows substantial heteroscedasticity, with the 1993 values having greater scatter at the lower end of the 1988 range.

The arc sine square root transformed values for 1993 were plotted against the arc sine square root transformed values for 1988. This plot, like the plot for the simple HMO Market Shares, shows an essentially linear relationship. This last plot probably shows slightly less hetero-scedasticity than does the simple market share plot. However, the difference between the arc sine square root transformation and the simple market shares is small. Any advantage that the arc sine square root transformation may have is not sufficient to justify the additional complexity of formulation and interpretation that would be entailed by its use.

possible double regression was done, but every single variable was included in double regressions at least twice. Similarly, all variables that showed moderately promising results were tried in every possible combination with each other.

Several variables that showed absolutely no explanatory power in the single and double regressions were discarded from the analysis. Over 20 triple and quadruple regressions were run for the 1970s and over 50 for the 1990s. For both periods, 1 particular quadruple specification maximized Adjusted $R^2$. When specifications with 5 explanatory variables were run, they yielded virtually no increase in explanatory power.[93]

For both of the final models, standard statistical diagnostic methods were applied. The assumptions that the residuals were normally distributed, independent of explanatory variables and independent of each other were tested both by visual inspection and the generation of summary statistics. The residuals were examined and analyzed to determine the number of influential observations and the extent of their influence.[94] The analysis of residuals failed to refute the statistical assumptions, and the final models are reasonably robust to the elimination of any 1 observation.

Please see Chapter 4 and Appendix B for further details on regression diagnostics.

---

[93] For the 1970s, the chosen quadruple regression had an Adjusted $R^2$ of .5830; none of the other regressions, including a couple of quintuple regressions, yielded as high an Adjusted $R^2$. For the 1990s, the chosen quadruple regression yielded an Adjusted $R^2$ of .2023. When all the plausible variables were tried as 5th explanatory Vs, none of the regressions produced an Adjusted $R^2$ of greater than .2038.

[94] Applied Linear Regression by Sanford Weisberg, 1985, pp 106, 118-125.

## E. Chapter Summary

The purpose of this chapter is to explain how the analysis of HMO enrollment growth was performed. In the course of doing so, the chapter explains how a number of methods issues were resolved. This explanation is intended to help the reader assess and interpret the study results that are presented in Chapter 4.

Section A presents the study population, the 75 largest MSAs in the U.S. It also describes the outcome variable, growth in HMO market share over each of two 5-year periods, and the 25 explanatory variables that were statistically tested. The testing was conducted using ordinary least squares (OLS) multiple regression.

The critical methods issues for this study are addressed in Section B. The well known statistical issues of omitted variables, endogeneity and measurement error are considered and addressed. Endogeneity is addressed using the growth prediction method, discussed in sub-section B2, rather than the more common 2 Stage Least Squares (2SLS) method. Another potential problem, discussed in sub-section B3, is the limited availability of the dependent variable in the 1970s data set (limited dependent variable). Potential problems this could cause are addressed through the use of supplemental analyses, the results of which will be discussed in Chapter 4. Section B of this chapter concludes with a discussion of the framing and prioritization of the statistical hypotheses.

Section C presents the sources and limitations of the data. Section D discusses model specification and the construction of the regression program. One major specification issue concerns whether to apply a log transformation to the outcome variable before conducting the analysis. However, application of a log transformation would implicitly assume that MSAs with high HMO market share experienced greater variation in growth. Observed values do not support such an assumption, so log transformation is not warranted. The regression program tests numerous combinations of explanatory variables in search of the combination that offers the best explanation of observed HMO growth.

The most important conclusion from this chapter is that the data and methods are suitable to analysis of HMO growth at the MSA level. Possible threats to validity are avoided or mitigated through the use of precautions. By providing a detailed description of data and methods, this chapter sets the stage for, and facilitates the understanding of, the presentation of statistical findings in the following chapter.

## Chapter 4: FINDINGS

"I remember the rage I used to feel when a prediction went awry."
BF Skinner[95]

In this research, multiple regression is used to develop models linking HMO growth at the MSA level to a small number of causal factors. This is done twice, first for the 1973-78 period, then for the 1988-93 period. This chapter is largely built around a series of tables that present the results of the regression analysis and place it within context.

Section A (Tables 4-1 to 4-5) presents descriptive statistics for both outcome and explanatory variables. Section B (4-6 to 4-10) presents the results of a number of regression runs, including those for the 2 final models. Section B briefly refers to the diffusion framework presented in Chapter 1 to help explain these results, but the results are fully integrated into this framework in Chapter 5, Conclusions. Section C (4-11) considers diagnostic analysis of the final models.

### A. Descriptive Statistics

A1 OUTCOME VARIABLE

Table 4-1 presents all values of the Outcome Variable used in the regression analyses. Table 4-2 presents basic summary statistics for this variable. Table 4-3 provides a more analytic summary.

In 4-1, metropolitan areas (MSAs) are listed in order of population as of 1990. In all cases, HMO Market Share is defined as the percentage of an MSA's total population enrolled in HMOs. In Table 4-1 market share is shown for the years 1973 and 1978, followed by the growth from 1973 to 1978. The second half of the table shows market share for the years 1988 and 1993 followed by 1988-93 growth.

As discussed in Chapter 1, Background, in 1973 only 28 of these 75 MSAs had positive HMO enrollments. For those 28, HMO market share ranged from .20% for Philadelphia to 24.05% for Sacramento. 16 of these 28 had a market share of less than 3.0%, which shows the fledgling nature of the national HMO movement at that time. By 1978, 46 of these MSAs had positive HMO enrollment, including 27 of the 28 that had positive HMO enrollment in 1973. Positive market shares ranged from .01% in Tampa to 25.22% for the Consolidated San Francisco Bay Area MSA. Of the 46 MSAs with positive enrollment in 1978, 28 had a market share of less than 3.0%.

Table 4-2 gives basic summary statistics for the outcome variables listed in Table 4-1. Growth in HMO market share in percentage points from 1973 to 1978 constitutes the 1st outcome variable for this project. 45 MSAs show positive market share growth, and 1 shows negative growth. (1 other MSA with negative growth, Stockton, was excluded from this data set.) The remaining 28 MSAs had zero enrollment in both 1973 and 1978.

---

[95] Walden Two, 1948

# TABLE 4-1
# GROWTH IN HMO MARKET SHARE

From 1973 to 1978 and from 1988 to 1993
For 75 Largest MSAs in the US

| Rank 1990 | Name | HMOMS73 % of Pop | HMOMS78 % of Pop | Growth 1973-78 | HMOMS88 % of Pop | HMOMS93 % of Pop | Growth 1988-93 | Abbrev |
|---|---|---|---|---|---|---|---|---|
| 1 | New York | 3.94 | 4.76 | 0.82 | 12.08 | 15.71 | 3.63 | NY |
| 2 | Los Angeles | 14.80 | 16.23 | 1.43 | 29.31 | 32.93 | 3.62 | LA |
| 3 | Chicago | 0.49 | 1.86 | 1.37 | 18.69 | 19.52 | 0.83 | Chi |
| 4 | Wash-Balt | 2.04 | 4.04 | 2.00 | 18.08 | 26.20 | 8.12 | Wash |
| 5 | San Fran | 21.96 | 25.22 | 3.26 | 39.10 | 40.88 | 1.78 | SF |
| 6 | Phil | 0.20 | 1.27 | 1.07 | 17.14 | 28.96 | 11.82 | Phil |
| 7 | Boston | 0.71 | 1.96 | 1.25 | 21.86 | 34.82 | 12.96 | Bos |
| 8 | Detroit | 2.19 | 2.79 | 0.60 | 19.20 | 21.42 | 2.22 | Det |
| 9 | Dallas | 0.00 | 0.00 | 0.00 | 10.60 | 12.47 | 1.87 | Dal |
| 10 | Houston | 0.00 | 0.60 | 0.60 | 11.32 | 11.55 | 0.23 | Hou |
| 11 | Miami | 0.00 | 4.78 | 4.78 | 18.61 | 27.56 | 8.95 | Mia |
| 12 | Seattle | 10.35 | 15.89 | 5.54 | 17.06 | 18.99 | 1.93 | Sea |
| 13 | Atlanta | 0.00 | 0.00 | 0.00 | 10.73 | 13.25 | 2.52 | Atl |
| 14 | San Diego | 6.21 | 11.57 | 5.36 | 22.64 | 33.80 | 11.16 | SD |
| 15 | Cleveland | 3.28 | 4.91 | 1.63 | 21.18 | 17.21 | -3.97 | Clv |
| 16 | Minn-SP | 3.83 | 10.93 | 7.10 | 46.04 | 39.48 | -6.56 | Min |
| 17 | St Louis | 1.83 | 2.38 | 0.55 | 14.39 | 20.03 | 5.64 | StL |
| 18 | Phoenix | 2.65 | 6.60 | 3.95 | 15.26 | 21.74 | 6.48 | Phx |
| 19 | Tampa | 0.00 | 0.01 | 0.01 | 9.00 | 13.71 | 4.71 | T-SP |
| 20 | Pittsburgh | 0.00 | 1.11 | 1.11 | 8.56 | 16.57 | 8.01 | Pitt |
| 21 | Denver | 3.52 | 8.14 | 4.62 | 24.60 | 25.83 | 1.23 | Den |
| 22 | Cincinnati | 0.00 | 1.26 | 1.26 | 11.71 | 19.31 | 7.60 | Cin |
| 23 | Milwaukee | 2.26 | 6.73 | 4.47 | 32.74 | 33.89 | 1.15 | Mil |
| 24 | Kansas City | 0.64 | 1.14 | 0.50 | 15.41 | 18.11 | 2.70 | KC |
| 25 | Portland | 15.92 | 22.01 | 6.09 | 35.71 | 50.07 | 14.36 | Port |
| 26 | Sacramento | 24.05 | 25.05 | 1.00 | 39.24 | 45.52 | 6.28 | Sac |
| 27 | Norfolk | 0.00 | 0.00 | 0.00 | 9.15 | 12.14 | 2.99 | Nor |
| 28 | Columbus | 0.00 | 0.16 | 0.16 | 19.30 | 21.60 | 2.30 | Col |
| 29 | San Ant | 0.42 | 1.06 | 0.64 | 12.06 | 8.96 | -3.10 | KC |
| 30 | Indnpls | 0.00 | 1.31 | 1.31 | 30.63 | 12.68 | -17.95 | Ind |
| 31 | New Orl | 0.00 | 0.00 | 0.00 | 12.01 | 12.11 | 0.10 | Nor |
| 32 | Charlotte | 0.00 | 0.00 | 0.00 | 2.22 | 7.34 | 5.12 | Chlt |
| 33 | Hartford | 0.00 | 0.73 | 0.73 | 13.42 | 24.90 | 11.48 | Hart |
| 34 | Orlando | 0.00 | 0.00 | 0.00 | 15.81 | 18.43 | 2.62 | Orl |
| 35 | Salt Lake | 0.00 | 2.18 | 2.18 | 21.07 | 35.14 | 14.07 | SLC |
| 36 | Rochester | 0.93 | 5.20 | 4.27 | 42.40 | 60.80 | 18.40 | Roch |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 37 | Nashville | 0.00 | 0.00 | 0.00 | 10.48 | 5.57 | -4.91 | Nash |
| 38 | Memphis | 0.00 | 0.00 | 0.00 | 11.14 | 15.63 | 4.49 | Mem |
| 39 | Buffalo | 0.00 | 0.00 | 0.00 | 32.83 | 41.14 | 8.31 | Buf |
| 40 | Ok City | 0.00 | 0.00 | 0.00 | 7.28 | 6.58 | -0.70 | Okl |
| 41 | Louisville | 0.00 | 1.05 | 1.05 | 12.86 | 22.30 | 9.44 | Lvl |
| 42 | Dayton | 0.00 | 0.00 | 0.00 | 13.77 | 28.25 | 14.48 | Day |
| 43 | Grnboro | 0.00 | 2.30 | 2.30 | 10.02 | 16.89 | 6.87 | Grnb |
| 44 | Prov | 1.90 | 2.52 | 0.62 | 22.04 | 21.71 | -0.33 | Prov |
| 45 | Jacksonvl | 0.00 | 0.00 | 0.00 | 18.55 | 22.99 | 4.44 | Jax |
| 46 | Albany | 0.00 | 1.47 | 1.47 | 23.42 | 32.82 | 9.40 | Alb |
| 47 | Richmond | 0.00 | 0.00 | 0.00 | 16.96 | 19.99 | 3.03 | Rich |
| 48 | Palm B | 0.00 | 0.00 | 0.00 | 2.73 | 3.31 | 0.58 | WPB |
| 49 | Brmnghm | 0.00 | 0.16 | 0.16 | 15.55 | 20.37 | 4.82 | Birm |
| 50 | Honolulu | 14.95 | 22.21 | 7.26 | 26.90 | 25.56 | -1.34 | Hon |
| 51 | Austin | 0.00 | 0.00 | 0.00 | 15.21 | 23.36 | 8.15 | Aus |
| 52 | Fresno | 0.00 | 0.00 | 0.00 | 2.62 | 16.67 | 14.05 | Fres |
| 53 | Las Vegas | 2.60 | 0.00 | -2.60 | 10.68 | 16.52 | 5.84 | LV |
| 54 | Raleigh | 0.00 | 0.00 | 0.00 | 30.65 | 15.34 | -15.31 | R-D |
| 55 | Scranton | 0.00 | 0.00 | 0.00 | 1.56 | 10.31 | 8.75 | Scr |
| 56 | Tulsa | 0.00 | 0.00 | 0.00 | 14.40 | 22.23 | 7.83 | Tul |
| 57 | Grand Rap | 0.00 | 0.00 | 0.00 | 28.76 | 24.84 | -3.92 | GRap |
| 58 | Allentown | 0.00 | 0.27 | 0.27 | 0.00 | 3.50 | 3.50 | Alln |
| 59 | Tucson | 0.96 | 6.06 | 5.10 | 36.91 | 35.67 | -1.24 | Tuc |
| 60 | Syracuse | 0.00 | 0.42 | 0.42 | 19.65 | 15.54 | -4.11 | Syr |
| 61 | Greenville | 0.00 | 0.89 | 0.89 | 9.97 | 4.46 | -5.51 | Grnv |
| 62 | Omaha | 0.00 | 1.24 | 1.24 | 9.13 | 11.13 | 2.00 | Om |
| 63 | Toledo | 0.00 | 0.00 | 0.00 | 17.35 | 22.87 | 5.52 | Tol |
| 64 | Knoxville | 0.00 | 0.00 | 0.00 | 8.48 | 3.84 | -4.64 | Knx |
| 65 | Springfield | 0.00 | 1.41 | 1.41 | 5.95 | 21.30 | 15.35 | Spr |
| 66 | El Paso | 0.00 | 0.65 | 0.65 | 1.27 | 3.51 | 2.24 | EP |
| 67 | Harrisburg | 0.00 | 0.00 | 0.00 | 17.20 | 11.57 | -5.63 | Hart |
| 68 | Bakersfield | 0.46 | 0.49 | 0.03 | 2.38 | 12.64 | 10.26 | Bak |
| 69 | Little Rock | 0.00 | 0.00 | 0.00 | 9.11 | 16.98 | 7.87 | LR |
| 70 | Charleston | 0.00 | 0.00 | 0.00 | 3.31 | 7.56 | 4.25 | Chln |
| 71 | Youngstown | 0.00 | 0.00 | 0.00 | 5.99 | 3.13 | -2.86 | Yng |
| 72 | Stockton | 15.68 | 0.92 | -14.76 | 17.60 | 29.40 | 11.80 | Stk |
| 73 | Albuqrqe | 4.58 | 6.11 | 1.53 | 36.17 | 44.74 | 8.57 | Albq |
| 74 | Wichita | 0.00 | 0.00 | 0.00 | 10.48 | 8.08 | -2.40 | Wich |
| 75 | Sarasota | 0.00 | 0.00 | 0.00 | 0.00 | 0.70 | 0.70 | Sar |

## TABLE 4-2
## BASIC STATISTICS FOR OUTCOME VARIABLE

HMO Market Share Growth:
2 Periods, 1973-78 and 1988-93
All Units shown as Percentages of MSA Population

| Period | # of Obs. | Min % | Max % | Mean % | Standard Deviation |
|---|---|---|---|---|---|
| 1973-78 | 46 | -2.60 | 7.26 | 1.99 | 2.12 |
| 1988-93 | 75 | -17.94 | 18.40 | 3.78 | 6.59 |

## TABLE 4-3
## ANALYTIC STATISTICS FOR OUTCOME VARIABLE

1973-78 and 1988-93 Periods
*Estimates Based on Published InterStudy Data*

| GEO-CHRONOLOGICAL SET | DEFINITION | TOTAL HMO ENROLLMENT | MEAN MSA ENROLLMENT | MSA LEVEL STD DEV |
|---|---|---|---|---|
| | | (in 000s) | (in 000s) | (in 000s) |
| ***1970s Statistics*** | | | | |
| 46 MSAs 1973 | 1970s Analytic Frame | 4,856 | 106 | 286 |
| 46 MSAs 1978 | 1970s Analytic Frame | 7,050 | 153 | 335 |
| 46 MSAs 1973-78 | *% Growth* | *45%* | *45%* | |
| | | | | |
| Entire US 1973 | | 4,937 | DNA | DNA |
| Entire US 1978 | | 7,471 | DNA | DNA |
| Entire US 1973-78 | *% Growth* | *51%* | | |
| | | | | |
| ***Late 1980s and Early 1990s Statistics*** | | | | |
| 75 MSAs 1988 | 1990s Study Population | 28,452 | 379 | 633 |
| 75 MSAs 1993 | 1990s Study Population | 36,662 | 489 | 783 |
| 75 MSAs 1988-93 | *% Growth* | *29%* | *29%* | |
| | | | | |
| Entire US 1988 | | 32,501 | DNA | DNA |
| Entire US 1993 | | 42,357 | DNA | DNA |
| Entire US 1988-93 | *% Growth* | *30%* | | |
| | | | | |

Growth for 1973-78 ranged from negative 2.60 percentage points in Las Vegas to 7.26 percentage points in Honolulu.[96] Of the 45 MSAs showing positive growth, 33 show growth of less than 3 percentage points of MSA population. During this period, the HMO movement progressed in many cities by either the establishment of small operational HMOs or by enrollment growth that was modest in absolute terms.

Table 4-3 tells much the same story for the 1973-78 period but in terms of pure percentage growth rather than as percentage points of population. Table 4-3 presents summary HMO enrollment statistics for various geographic entities for the 2 analysis periods. It shows that enrollment growth in the 46 cities included in my analysis (45%) was similar to that of the US as a whole (51%) for 1973-78.

However, for the 46 MSAs included, the standard deviation of HMO enrollment was more than twice the average enrollment in both 1973 and 1978.[97] This is a consequence of three metropolitan areas, Los Angeles, San Francisco and New York, accounting for the majority of HMO enrollment in these 46 cities throughout the 1973-78 period.

Tables 4-1, 4-2 and 4-3 show a different pattern of growth for the 1988-93 period. As shown in Table 1, by 1988 73 of the 75 MSAs had positive enrollment, and the last 2 holdouts, Allentown and Sarasota-Bradenton, surrendered by 1993.[98] In general, market share percentages were much larger then in the 1970s. In 1988, only 6 MSAs with positive HMO enrollment had a market share of less than 3%, and 21 MSAs had an enrollment of greater than 20% of their population. By 1993, only 1 MSA, Sarasota-Bradenton, had a market share of less than 3%, and 34 had an HMOMS of greater than 20%.

Once again, market share growth in percentage points is the outcome. 57 MSAs show positive growth, and 18 show negative growth. As shown in Table 4-2, the range was from -17.94% in Indianapolis to +18.40% in Rochester. The majority of the 75 MSAs experienced HMOMS growth of greater than +3%, and 12 cities saw HMOMS grow by more than 10% of population. These statistics reflect the instability of HMO enrollment at the MSA level during this period; rapid growth in many cities was partly balanced by substantial decline in several others.

Table 4-3 shows growth in pure percentages. Overall growth in the 75 cities (29%) continued to match enrollment growth in the country as a whole (30%). The standard deviation of HMO enrollment at the MSA level continued to be higher than the mean enrollment for these cities, but the ratio between the standard deviation and the mean had dropped to less than 2.0. HMO enrollment continued to be somewhat concentrated, but there was large absolute growth in HMO enrollment (>500,000) in east coast MSAs, notably Philadelphia, Washington-Baltimore and Boston as well as New York.

---

[96] As discussed in Chapter 3, Section D, the value of -14.76% for Stockton constitutes both an outlier and an inaccurate measurement.

[97] The relationship between the Mean and the Standard Deviation changes somewhat depending on whether the units are enrollees or percent of MSA population enrolled.

[98] It's not entirely clear whether the Florida Blue Cross HMO, Health Options, had enrollees in the Sarasota-Bradenton area in 1988.

## A2 EXPLANATORY VARIABLES

Table 4-4 presents 1970s summary statistics for the 25 explanatory variables used in the regression analysis. In order to understand the effects of any variable, it is necessary to understand the distribution of that variable. Similarly, coefficient values generated by regression analysis can only be understood if the typical values and the range of the explanatory variables are known. Table 4-3 presents much of this necessary background.

Table 4-4 lists the same 25 explanatory variables presented in the same order as in Tables 3-2 and 3-3.[99] For each variable, the table lists the year it was measured, the units of measurement and the minimum, maximum, mean and standard deviation (SD) values for the 46 observations included in the 1970s analysis. As mentioned in Table 3-2, the Longitude of Honolulu was changed for the purposes of this study. In order to reduce the influence of Honolulu on all analyses using this variable, the distance between that city and the next most westerly MSA (Portland) was approximately "cut" in half.

By and large, the aggregate statistics shown for the explanatory variables are consistent and reasonable. RNs only outnumbered MDs by less than 3 to 1. There were generally half or fewer LPNs as there were RNs in most MSAs, and Pharmacists were far outnumbered by MDs, not to mention RNs. The explanatory variable with the greatest relative variation is Population Density per square mile, which ranged from 45.5 to 1,907. This reflects the somewhat arbitrary definition of urban county employed by the Census Bureau.[100]

Examination of histograms of the explanatory variables for the 1970s (not included here) shows a variety of distributions, but few outrageous outliers and no truly freakish distributions. Population Density shows 2 conspicuous outliers, New York and Chicago, both with values in excess of 1,750 persons per square mile. Both of these values are more than 3 standard deviations above the mean and more than 1 standard deviation above the next highest value. For some statistical applications, log transformation of Population Density might be desirable to reduce the influence of these 2 observations.

Table 4-5 corresponds precisely to 4-4, except that it describes the explanatory variables for the 1990s analysis for all 75 MSAs in the study frame. As with Table 4-4, the aggregate statistics of minimum, maximum, mean and standard deviation, are consistent and reasonable. This table includes 3 new variables, Proportion of Family Physicians, Economic Growth and Population Growth. Examination of histograms for all 1990s explanatory variables (not included here), confirmed that their distribution is generally favorable to the application of linear regression analysis. Once again, the Longitude of Honolulu was altered to reduce that observation's potential influence, and Chicago and New York were outliers to the distribution of Population Density, with values in excess of 3 standard deviations above the mean.

Please see Appendix C for a brief analytic comparison of the 1970s and 1990s values for the explanatory variables.

---

[99] This is why Table 4-3 includes 3 variables for which no data were available for the 1970s analysis.

[100] However, any definition of urban area for the U.S. would have some arbitrary applications, and the census method, then and now, reflects the reality that urban areas are structured and perceived differently in different parts of the country.

# TABLE 4-4
# DESCRIPTIVE STATISTICS FOR EXPLANATORY VARIABLES

Period 1 - 1973-78, For the 46 MSAs included in the analysis

| # | VARIABLE | Year Measured | Units | Min | Max | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 1 | Hospital Beds per capita | 1973 | Gen Hosp Beds per 100 Pop | .317 | .778 | .472 | .091 |
| 2 | MDs per capita | 1973 | MDs per 100 Pop | .088 | .235 | .164 | .036 |
| 3 | RNs per capita | 1972 | RNs per 100 Pop | .209 | .580 | .380 | .101 |
| 4 | LPNs per capita | 1974 | LPNs per 100 Pop | .120 | .290 | .179 | .038 |
| 5 | Pharmacists per capita | 1974 | Reg. Pharms per 100 Pop | .023 | .091 | .051 | .011 |
| 6 | Hospital Days per capita | 1973 | Gen Hosp Days per Person | .800 | 2.10 | 1.32 | .268 |
| 7 | Hospital Expenditures per capita | 1975 | $ Gen Hosp Exp per Person | 112 | 291 | 213 | 43.1 |
| 8 | Hospital Costs per day | 1973/1975 | Approx $ Costs per Hosp Day | 75.0 | 221 | 164 | 28.0 |
| 9 | Proportion MDs AMA Members | 1971 | Prop Phys AMA Mem (in State) | .373 | .761 | .617 | .105 |
| 10 | Proportion MDs Aged 45-64 | 1975 | Prop Phys Aged 45-64 | .295 | .509 | .370 | .047 |
| 11 | Proportion of FPs | N/A | | | | | |
| 12 | % Physicians in Group Practice | 1975 | % Phys in Group Pract (in State) | 13.6 | 55.5 | 24.6 | 8.52 |
| 13 | Blue Cross/Blue Shield Market Share | 1973 | Prop of Pop Ins by BC/BS Plans | 0 | .764 | .340 | .182 |
| 14 | Age of Oldest HMO | 1978 | # of Years HMOs Operate in MSA | 0[101] | 49.8 | 10.9 | 13.2 |

Table continued following page

[101] In 1978 there was no operational HMO in Las Vegas. Additionally, Age of Oldest HMO was set at 0 for 3 MSAs where HMOs had been in operation less than a year.

**TABLE 4-4, continued**

## DESCRIPTIVE STATISTICS FOR EXPLANATORY VARIABLES

| # | VARIABLE | Year Measured | Units | Min | Max | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 15 | Per Capita Income | 1978 | $ Per Cap Inc w Adjustments | 5,608 | 9,002 | 7,700 | 741 |
| 16 | Economic Growth | N/A | | | | | |
| 17 | Employees per Establishment | 1979 | Est Avg # of Emp per Est | 12.1 | 24.8 | 18.3 | 2.75 |
| 18 | % Workers Union Members | 1976 | % Workers Union Members (State) | 6.6 | 37.1 | 25.2 | 9.04 |
| 19 | Population Density | 1975 | Pers per Sq Mi | 45.5 | 1,907 | 523 | 398 |
| 20 | Population Growth | N/A | | | | | |
| 21 | Net Migration | 1970-77 | Net Mig as a % of MSA Pop | -8.2 | 27.7 | 3.17 | 8.93 |
| 22 | Average Schooling[102] | 1980 | Approx Median Yrs Schooling | 11.64 | 12.77 | 12.02 | .17 |
| 23 | 8 Regional Dummies[103] | DNA | 0-1 | DNA | DNA | DNA | DNA |
| 24 | Relative Latitude | DNA | Ten-Thousandths of a Degree | -156,000 | 106,000 | 10,000 | 54,000 |
| 25 | Relative Longitude | DNA | Ten-Thousandths of a Degree | -188,000 | 460,000 | 35,000 | 179,000 |

Please see Table 3-3, accompanying text in Chapter 3, and Appendix J for further information on explanatory variables.

[102] 1980 estimated values for Median Schooling turned out to be unpromising because 36 of 46 computed Medians equaled exactly 12.0.

[103] Regional Dummies reflect the New England, Mid Atlantic, South Atlantic, E. North Central, W. North Central, South Central, Mountain and Pacific Regions.

## TABLE 4-5
## DESCRIPTIVE STATISTICS FOR EXPLANATORY VARIABLES

Period 2 - 1988-93, For the 75 largest MSAs in the US

| # | VARIABLE | Year Measured | Units | Min | Max | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 1 | Hospital Beds per capita | 1989 | Gen Hosp Beds per 100 Pop | .220 | .754 | .403 | .108 |
| 2 | MDs per capita | 1989 | MDs per 100 Pop | .122 | .503 | .235 | .060 |
| 3 | RNs per capita | 1990 | RNs per 100 Pop | .405 | 1.18 | .825 | .158 |
| 4 | LPNs per capita | 1990 | LPNs per 100 Pop | .089 | .367 | .173 | .057 |
| 5 | Pharmacists per capita | 1990 | Regist Pharms per 100 Pop | .044 | .133 | .081 | .018 |
| 6 | Hospital Days per capita | 1989 | Gen Hosp Days per Person | .507 | 1.99 | 1.02 | .293 |
| 7 | Hospital Expenditures per capita | 1990 | $ Gen Hosp Exp per Person | 496 | 1,472 | 943 | 206 |
| 8 | Hospital Costs per day | 1989/90 | Approx $ Costs per Hosp Day | 561 | 1,236 | 949 | 149 |
| 9 | Prop. MDs AMA Members | N/A | | | | | |
| 10 | Prop MDs Aged 45-64 | 1989 | Prop MDs Aged 45-64 | .243 | .466 | .343 | .040 |
| 11 | Proportion of FPs | 1989/90 | Prop MDs Ident as FPs or GPs | .048 | .232 | .121 | .041 |
| 12 | % Physicians in Group Practice | 1988 | % Phys in Group Pract (in State) | 14.7 | 63.5 | 28.7 | 8.9 |
| 13 | BC/BS Market Share | N/A | | | | | |
| 14 | Age of Oldest HMO | 1992 | # of Years HMOs Operate in MSA | 0 | 63.8 | 18.2 | 13.6 |
| 15 | Per Capita Income | 1993 | $ Per Cap Inc w Adjustments | 13,172 | 29,140 | 20,255 | 2,598 |

Table continued following page

## TABLE 4-5, continued
## DESCRIPTIVE STATISTICS FOR EXPLANATORY VARIABLES

| # | VARIABLE | Year Measured | Units | Min | Max | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 16 | % Economic Growth | 1978-93 | % Growth in Mean Current $ Per Capita Inc | 104 | 234 | 164 | 29 |
| 17 | Employees per Establishment | 1993 | Est Avg # of Emp per Est | 10.3 | 19.9 | 16.0 | 2.04 |
| 18 | % Workers Union Members | 1994 | % Workers Union Members (State) | 3.8 | 28.9 | 14.7 | 6.88 |
| 19 | Population Density | 1993 | Persons per Square Mile | 73.6 | 2,004 | 527 | 365 |
| 20 | % Population Growth | 1970-93 | % Growth in Pop | -13 | 222 | 44.3 | 45.1 |
| 21 | Net Migration | 1991 | Net Mig as a % of MSA Pop | -1.38 | 7.4 | .71 | 1.19 |
| 22 | Average Schooling | 1990 | Approx Mean Yrs Schooling[104] | 11.98 | 13.73 | 12.92 | .35 |
| 23 | 8 Regional Dummies[105] | DNA | 0-1 | DNA | DNA | DNA | DNA |
| 24 | Relative Latitude | DNA | Ten-Thousandths of a Degree | -156,000 | 106,000 | 10,000 | 54,000 |
| 25 | Relative Longitude | DNA | Ten-Thousandths of a Degree | -188,000 | 460,000 | 35,000 | 179,000 |

Please see Table 3-3, accompanying text in Chapter 3, and Appendix J for further information on explanatory variables.

[104] This variable was computed somewhat differently (and more usefully) for 1990 than for 1980.

[105] Regional Dummies reflect the New England, Mid Atlantic, South Atlantic, E. North Central, W. North Central, South Central, Mountain and Pacific Regions.

## B. Regression Results

B1 TESTING ALL VARIABLES

The statistical inference process began with simple, or single, ordinary least squares (OLS) regression of the HMO Market Share on all of the explanatory variables. Detailed results, including several tables, are presented in sub-sections B2 to B9. This sub-section discusses some of the patterns and issues that arose over the course of both sets of analysis.

For a few variables, initially strong results were "soaked up" when the variable was included in multiple regressions. For the 1970s, Age of Oldest HMO showed a t statistic of 2.78 in the 1970s single regression. But when this variable was included in a regression with Group Practice and MD per capita variables, the effect completely disappeared (t = -.55). A possible 1990s effect of the concentration of Licensed Professional Nurses (LPNs) was not robust to the addition of Economic Growth and Physician (MD) variables in double regressions.[106]

One major specification decision was whether to use Income or Economic Growth in the final 1990s model. These 2 variables are highly correlated (r =.67), and behave in a remarkably similar manner throughout the analysis. Single regressions with Income and Economic Growth yield t statistics of -3.46 and -3.10 respectively. Both variables continue to show substantial effects when placed in more complex regressions. But when these 2 variables are included in the same regression, the magnitude of one or both t statistics goes down considerably even though the model goodness of fit, as measured by $R^2$, remains competitive.

Under this circumstance, the principle of parsimony called for only including one of these variables in the final model. The prior hypothesis was that Economic Growth had a negative effect on HMO growth during the 1988-93 period (Markovich 1999). As discussed in Chapter 3, the HMO bust of the late 1980s most greatly affected cities that had seen the most spectacular HMO growth in the mid 1980s, and these tended to be MSAs experiencing rapid population and economic growth.

Because of this observation, it made more sense to test for a statistical association with economic growth rather than with high-income levels per se.[107]

B2 FINAL 1970s MODEL:

Table 4-6 shows the final result of the 1970s regression program. A model using Group Practice, MDs per capita, RNs per capita and Latitude was chosen to explain growth in HMO market share. Higher values of the first 3 variables are likely to increase HMO growth.

---

[106] Likewise, initially weak results do not preclude a variable showing an association when other variables are controlled for. In the 1970s data set, Latitude showed no indication of a statistically significant association in single and double regressions. However, when it was added to a regression including the Group Practice, MD and RN variables, a strong association appeared.

[107] This was a serious decision. Economic prosperity, as expressed by per capita income, and economic growth are 2 very different concepts, and their measures are not necessarily highly correlated. The issue might be resolved by the use of additional observations and more sophisticated techniques. Two ways of adding more data would be to generate observations for more MSAs and to lower the level of aggregation from MSA to County. If it were found that the effect was caused more by high income per se, then it might be explained by high income people perceiving HMOs as a less desirable form of insurance, a perception that probably grew throughout the 1990s.

# TABLE 4-6
# FINAL 1970s MODEL
# FOR GROWTH IN HMO MARKET SHARE

ANOVA Table and t Statistics:

ANOVA TABLE

| SOURCE | SS | df | MS | N: | 46 |
|---|---|---|---|---|---|
| Model | 135 | 4 | 33.64 | F(4,41) | 20.4 |
| Residual | 67 | 41 | 1.65 | Prob > F | 0.0000 |
| Total | 202 | 45 | 4.49 | Adj $R^2$: | .63 |
| | | | | Root MSE: | 1.28 |

***t Statistics***

| Explanatory Variable | Coeff. | t Value | P Value |
|---|---|---|---|
| % Physicians in Group Practice | .172 | 7.52 | 0.000 |
| MDs per capita | 21.07 | 3.56 | 0.001 |
| RNs per capita | 9.25 | 3.71 | 0.001 |
| Relative Latitude | $-1.37 \times 10^{-5}$ | -3.15 | 0.003 |
| Intercept | -9.07 | -6.83 | 0.000 |

NOTE: Unit used to develop ANOVA table is Percentage Point Growth of MSA population enrolled in HMOs at MSA level from 1973 to 1978. The 1.28 Root Mean Square (RMS) value displayed at the lower right corner of ANOVA table means that the model predicts growth in HMO market share with a standard error (SE) of 1.28%. This value should be compared with the SD of HMO market share growth of 2.12%.[108]

---

Latitude, which measures a city's position along the north-south axis, was included as a control variable. The results show that higher latitudes are associated with less HMO market share growth.

The chosen specification yields the highest adjusted $R^2$ of any regression using 4 or fewer explanatory variables.[109] Sixty three percent of the variance in HMO market share growth is explained by the 4 variables used here.

The results of this regression can be explained in terms of estimating HMO market share and enrollment. Application of this model enables an analyst to reduce the Standard Deviation of the outcome variable of 2.12% to a Standard Error of 1.28%. For a Metropolitan Area in this

---

[108] Technically, the population standard deviation for HMO market share growth is 2.10%. Statistical software assumes that the data represents a sample rather than an entire population, and that is why this value is normally shown to be 2.12%.

[109] The specification with 5 explanatory variables that showed the highest adjusted $R^2$, 67%, included Hospital Beds as well as Group Practice, MDs, RNs and Latitude. However, given the small size of the 1970s data set (46 observations), I was cautious about adding explanatory variables.

data set with a population of 1.0 million, a naive analyst would apply the average growth of 1.99% of population, or an increase of 19,900 HMO members. Because of the Standard Deviation of 2.12%, or 21,200 people, the analyst could have little confidence in this estimate.

However, with the assistance of the 1970s model selected here, an analyst would generate a different estimate of enrollment growth for the same metropolitan area, one that would depend on the values of the Group Practice, MD, RN and Latitude variables for that city. Whatever that estimate might be, let's say 25,000 enrollees in this hypothetical case, it would be more reliable because the applicable Root Mean Squared Error (RMSE), comparable to the Standard Deviation, is only 1.28%, or 12,800 members.[110]

## B3 FINAL 70s MODEL AND ALTERNATIVE ANALYSES

*Alternative Model Specifications*

Because of the small number of observations used, it would have been unwise to construct a final model with a large number of explanatory variables. Such models showed little additional explanatory power, as measured by adjusted $R^2$, compared to the rather parsimonious model presented in the previous sub-section. However, in the interest of thoroughly analyzing the data, a very large number of regression specifications were tested, ranging from single regressions to numerous specifications with 4 explanatory variables and several with more than 4 independent variables.

One advantage of testing numerous specifications is the opportunity to check for robustness of effects of specific variables across specifications. Comparing the coefficients for one or more specific variables is a good way to do this.[111] Table 4-7 compares the results of the final model with 2 other stages of the analysis. The left part of the data in this Table presents results from the 22 single regressions that were performed for the 1970s. The center part presents results from the final model, repeating material from Table 4-6. The right part shows results from a regression selected using the Stata Stepwise algorithm.[112]

Table 4-7 shows the number and name of each variable. Three explanatory variables were not available for the 1970s analysis, but Table 4-7 maintains consistency with the variable numbering scheme of the other tables; therefore, variable numbers 11,16 and 20 are missing. For the single regressions, coefficients, t values and $R^2$ values are all presented. For the final and stepwise models, coefficients and t values are shown in adjacent columns, with the $R^2$ values shown in a separate row below the listed variables.

---

110 Admittedly, in such a case, the 95% Confidence Interval for such an estimate would still include zero growth. But the analyst could be confident that the MSA did not experience substantial decline in HMO membership.

This discussion sidesteps the more difficult issues of using the results to estimate HMO growth in cities not included in the data set or to "predict" growth for the included cities, but for periods other than the 1973-78 period that was analyzed. Unfortunately, there are no ready formulas to generate Standard Errors (SEs) for such estimates. But the use of Bayesian techniques and other estimation methods hold promise generating plausible and testable estimates of such SEs. For discussion of a similar problem, see Ghosh and Rao, "Small Area Estimation: An Appraisal" with Comments and Rejoinder, Statistical Science, February 1994, pp.55-93.

111 E-mail correspondence to author from Jerry Kominski, January 23, 2001

112 Stata Corporation, Reference Manual, Stata Press, Release 4, 1995, Vol. 3 pp 124-127. This algorithm employed forward stepwise regression. The Stata default parameters were used, except that fenter, the F value required for variable entry, was set at 1.0. The purpose here is not to endorse Stepwise regression or to promote its results. Rather, it is used to present a plausible and convenient specification that is less parsimonious than the final 1970s and 1990s models.

## TABLE 4-7
## COMPARISON OF VARIABLE COEFFICIENTS ACROSS MODEL SPECIFICATIONS
1970s Analysis

| # | Variable | Single Regressions | | | Final Model | | Stepwise Model | | Variable |
|---|---|---|---|---|---|---|---|---|---|
| | | Coefficient | t-statistic | Adjusted $R^2$ (%) | Coefficient | t-statistic | Coefficient | t-statistic | (abbrev.) |
| 1 | Hospital Beds per capita | -2.51 | -.72 | -1 | | | -25.3 | -2.91 | Beds |
| 2 | MDs per capita | 20.9 | 2.51 | 11 | 21.1 | 3.56 | 26.4 | 4.54 | MDs |
| 3 | RNs per capita | 5.82 | 1.91 | 6 | 9.25 | 3.71 | 11.2 | 4.32 | RNs |
| 4 | LPNs per capita | -4.16 | -.49 | -2 | | | -6.64 | -1.28 | LPNs |
| 5 | Pharmacists per capita | -.36 | -.01 | 0 | | | | | Pharms |
| 6 | Hospital Days per capita | -1.59 | -1.36 | 2 | | | 8.15 | 2.52 | H Days |
| 7 | Hospital Expenditures per capita | -.002 | -.33 | -2 | | | | | H Spend |
| 8 | Hospital Costs per day | .011 | .99 | 0 | | | | | H Costs |
| 9 | Proportion MDs AMA Members | 3.34 | 1.11 | 1 | | | | | AMA % |
| 10 | Proportion MDs Aged 45-64 | -7.45 | -1.10 | 0 | | | | | MD-Mid |
| 12 | % Physicians in Group Practice | .146 | 4.82 | 33 | .172 | 7.52 | .203 | 7.45 | Group P |
| 13 | BC/BS Market Share | -1.26 | -.73 | -1 | | | | | BC/BS |
| 14 | Age of Oldest HMO | .062 | 2.78 | 13 | | | | | Age HMO |
| 15 | Per Capita Income # | .308 | .07 | -2 | | | 7.57 | -2.75 | Income |
| 17 | Employees per Establishment | -.158 | -1.39 | 2 | | | | | Est. Size |
| 18 | % Workers Union Members | .002 | .06 | -2 | | | | | Union |
| 19 | Population Density | .0001 | .12 | -2 | | | | | Pop Dens |
| 21 | Net Migration | .029 | .81 | 1 | | | | | Mig |
| 22 | Average Schooling | 2.61 | 1.43 | 2 | | | | | Educ |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 23 | 8 Regional Dummies | -1.53 to 2.13 | -1.55 to 2.76 | -2 to 13 | | | Pac 1.23 EMidW .583 | Pac 1.85 EmidW 1.03 | 8 Dum |
| 24 | Relative Latitude* | -.123 | -.21 | -2 | -1.37 | -3.15 | -1.44 | -3.35 | Lat. |
| 25 | Relative Longitude* | 47.3 | 2.89 | 14 | | | | | Long. |
| | | | | | | | | | |
| | Number of Explanatory Variables | 1 | | | 4 | | 10 | | |
| | Adjusted $R^2$ (in %) | | | -2 to 33 | 63 | | 73 | | |

Notes: * Coefficients listed for Relative Latitude and Longitude are the actual regression coefficients multiplied by $10^5$ (100,000).

# Coefficients listed for Per Capita Income are the actual regression coefficients multiplied by $10^4$ (10,000)

For the 4 variables included in the final model, coefficients are all consistent in terms of sign (positive or negative). The MD variable shows the greatest consistency of magnitude, with the single and final models generating virtually identical coefficients. The stepwise regression generates an MD coefficient about 25% greater than do the 1st 2 models. Generally consistent coefficients were generated for the Group Practice variable, with a range of .146 to .203.

The coefficients of the RN variable vary by a factor of about 2, ranging from 5.82 in the single regression to 11.2 in the stepwise model. For Latitude, the coefficients are somewhat inconsistent. In single regression, Latitude generated a coefficient of -.123 and a laughable t-statistic of -.21. The Final and Stepwise models were quite consistent with each other for this variable.

Several variables not included in the final model show inconsistent results between single regression and stepwise model. For Hospital Days, the coefficient swings from –1.59 to 8.15 in the stepwise model. The coefficient of income changes by more than an order of magnitude, going from .308 to 7.57.
Overall, Table 4-7 tends to confirm that the coefficients of the selected final model show reasonable robustness. Conversely, none of the over two dozen variables excluded from the final model consistently showed substantial explanatory power.

*Testing of Final 1970s Model On Alternative Data Sets*
As previously mentioned, there is considerable diversity among the cities in the study frame in terms of the presence of ***any*** HMO enrollees in the years 1973 and 1978. Less than half of these 75 cities had operational HMOs in 1973. By 1978, there was positive HMO enrollment in 46 of them. Such qualitative changes, and the qualitative differences they create between cities in the full data set, need to be analyzed carefully. The primary analysis presented in sub-section B2 excludes the cities with no HMO enrollment throughout the 1973 to 1978 period. However, all 19 metropolitan areas that saw their first enrollment between 1973 and 1978 are included, boosting the sample size from 27 to 46.

To help assess the impact of these data set decisions, 3 supplementary analyses were conducted using the 4 explanatory variables from the final 1970s model. First, the model was used to estimate growth for the 27 cities with positive HMO enrollment in 1973.[113] This was to determine the performance of the model in predicting growth when the confounding issue of initial HMO establishment is eliminated. Second, the model was used to estimate HMO market share growth for a data set with 74 MSAs, almost the entire set for which data is available.[114] This was to determine the extent to which the addition of 28 cities with no HMO enrollment throughout the period detracts from the model's goodness of fit. Third, the 4 explanatory variables were used in a logistic regression to estimate initial HMO establishment (by 1978) for the 47 cities with no enrollment in 1973.

---

[113] Including Las Vegas, which had positive HMO enrollment in 1973, but no enrollment in 1978.

[114] For the reasons presented in Chapter 3, the city of Stockton, CA, is not included in any of the 1970s regression analyses presented in this chapter.

The results of these 3 supplemental analyses support the findings of the primary analysis with a few caveats. Regression analysis using the 27 cities with initial positive HMO enrollment shows a good fit between the model and the data, with a higher Adjusted $R^2$ for a smaller data set. The t-values and coefficients for the explanatory variables were generally consistent with those of the Final 1970s Model, with only the MDs per capita variable losing statistical significance in this supplemental analysis.

The results for the 2nd supplemental analysis are mixed. When the model is run on the set of 74 cities, the Group Practice and RNs per capita variables show moderate declines in t-values and coefficients, but they both comfortably retain statistical significance. The coefficient for MDs per capita gets cut to less than half its value in the primary analysis, and that variable loses statistical significance. Latitude shows no indication of any statistical relationship when tested with this larger data set.

Taken together, the primary 1970s analysis and the first 2 supplemental analyses indicate that the final model performs very well in explaining HMO growth in cities with established HMOs in 1973, quite well in explaining overall growth for those cities where operational HMOs were established between 1973 and 1978 and not well in explaining the lack of HMO operations in the remaining cities. This indication is supported by the 3rd supplemental analysis, which uses logistic regression to distinguish the 1973-78 startup cities from those that still had no HMO enrollment in 1978. The 3rd supplemental analysis indicates that these 4 variables are useless for this purpose.

Therefore these supplemental analyses are quite consistent in indicating the strengths and weaknesses of the Final 1970s Model. This model's poor performance in differentiating cities where HMOs were initiated from those where nothing happened suggests some caveats concerning the strength and interpretation of the primary results. The specific combination of cities in which HMOs were established and growing during the years 1973-78 may have had a substantial influence on the factors found to influence that growth. And if that specific combination did have a substantial influence, it would be desirable to know how that combination came about.[115]

However, the model's good performance at explaining growth once HMO operations began is favorable for comparing these results with those for the 1988-93 period. Since HMOs operated in 73 out of 75 metropolitan areas by 1988, the initiation of operational HMOs is not a major factor in explaining HMO growth during the later period. Therefore, the comparison of the 1970s results with those for the early 1990s (see sub-section B9) holds particular interest.

For the specific results of the 3 supplemental 1970s analyses, please see Appendix H.

---

[115] Most saliently, was the successful establishment of an initial HMO in some of these cities primarily a random process? If so, we could imagine that the magnitude and pattern of HMO growth in the 1970s would have been very different had that initial "roll of the dice" turned out differently. However, given the economic, social and political significance of the small HMOs of that era, I believe a far more exhaustive investigation would be needed before disregarding the numerous plausible hypotheses concerning causal factors lying behind these organizations existence or non-existence during this seminal period.

B4 PHYSICIAN VARIABLES IN THE FINAL 1970s MODEL

These results, particularly the 7.5 t-statistic for Group Practice, show that physician related variables account for the bulk of this model's explanatory power. A double regression using just the Group Practice and MD variables generated an adjusted $R^2$ of 52%.[116] This is the single most important finding of the analysis of the 1st period. It can be plainly expressed in the phrase "It was the Docs."

As shown in Table 3-2, the Group Practice variable was hypothesized to influence HMO growth because physicians in group practice were believed to more open to the HMO style of practice, specifically the supervision HMOs imposed to control costs and insure quality of care. In fact, early HMOs were referred to as Prepaid Group Practices (PGPs). Therefore physicians in states with a tradition of the group practice of medicine were more willing to affiliate with HMOs and treat HMO enrollees.[117]

As was discussed in Chapter 3, the explanatory variables were chosen to exclude endogenous effects. For the health related explanatory variables, taking the measurement at the beginning of the period did the trick. However, for a number of these variables, including Group Practice, it was not possible to collect measurements for the exact beginning of the growth period, the year 1973.

The percentage of MDs in group practice, on the state level, was available for 1975, and that data were used to generate the Group Practice variable used in the final 1970s model. When a very strong effect of this variable was found, Glenn Melnick raised the concern that the 1975 Group Practice values may include an endogenous component. If HMO growth caused greater numbers of physicians to practice within groups, then the 1975 Group Practice values reflect HMO growth for the period 1973 to 1975. There would be little value to using such values to explain HMO growth for the overlapping 1973 to 1978 period.

To test whether the effect of 1975 Group Practice values on HMO growth stemmed from the endogenous nature of the 1975 measurements, I reran the final 1970s model using Group Practice values for 1969 instead of 1975.[118] The results for both the final model and the alternative specification are shown in Table 4-8.

When the model was run with the 1969 values of Group Practice, this variable showed a positive association with HMO growth (t=5.60). This is not as high as the 7.52 value in the final model, but it constitutes an extremely strong association. With the 1969 values, the

---

[116] By contrast, a double regression using the RN and Latitude variables generated an adjusted R2 of only 9%.

[117] The term PGP is discussed in Luft, Harold, HMOs: Dimensions of Performance, Transaction Books, 1987 (originally published 1981), pp. 1-7. Also see an early work on HMOs, MacColl, William A., Group Practice and Prepayment of Medical Care, Public Affairs Press, 1966.

However, group practice in the 1960s and 1970s was not synonymous with physician HMO employment or affiliation, just as those 2 concepts are not synonymous today. What these results show is that, for many physicians, familiarity with Group Practice was an important pre-cursor to HMO affiliation or employment. In fact, even as HMOs began to move away from a strict group practice structure, MSAs in states with a strong group practice tradition experienced the most rapid HMO enrollment growth.

[118] 1969 was the most recent year previous to 1975 for which the AMA had collected MD Group Practice statistics. Roemer et al analyzed these statistics in a 1974 Medical Care article.

## TABLE 4-8
## ALTERNATE 1970s MODEL
## USING PRIOR VALUES FOR GROUP PRACTICE VARIABLE

Regression Results Compared w those for Final Model
(Outcome Variable remains Growth in HMO Market Share 1973-1978)

| | w 1969 Values for Group Practice | | w 1975 Values for Group Practice | |
|---|---|---|---|---|
| Explanatory Variable | Coeff. | t Value | Coeff. | t Value |
| % Physicians in Group Practice | .203 | 5.60 | .172 | 7.52 |
| MDs per capita | 22.13 | 3.12 | 21.07 | 3.56 |
| RNs per capita | 9.25 | 3.15 | 9.25 | 3.71 |
| Relative Latitude | $-1.07 \times 10^{-5}$ | -2.11 | $-1.37 \times 10^{-5}$ | -3.15 |
| Intercept | -8.07 | 5.30 | -9.07 | -6.83 |
| Adjusted $R^2$ | .51 | | .63 | |
| N | 45[119] | | 46 | |

coefficient for Group Practice is .203, higher than the coefficient of .172 for the 1975 values. This is because the average value for this variable was much lower in 1969.[120] Therefore the higher coefficient is consistent with the lower t value and the somewhat weaker association found with the older values.

Table 4-8 also shows that the t-statistics for the other explanatory variables go down moderately when the older values for Group Practice are used. However, the alternative specification still shows that these variables have a significant association with HMO growth. As would be expected, the alternative specification yields a lower adjusted $R^2$ of 51.

In my opinion, the "decline" of the t-statistic and the adjusted $R^2$ is not due to an endogenous component in the 1975 value. Rather, the 1975 values accurately reflect the group practice environments that influenced HMO growth, and the 1969 values are older data that naturally show less of an effect.[121] The main point is that the effect of Group Practice on HMO growth is robust when tested by using data from before the beginning of the growth period.

The other MD variable found to effect HMO growth is the concentration, or supply, of MDs per unit of MSA population. As shown in Table 3-3, this variable was measured in 1973, the beginning of the growth period. Table 3-2 shows the initial hypothesis that a greater supply of MDs would spur HMO growth. The reason for this was simple. A larger number of

[119] No value for this variable was available for Washington DC in 1969.

[120] In this particular data set, the average value for Percent of Physicians in Group Practice is 14.97% for 1969 and 24.57% for 1975.

[121] If MSA level data on Group Practice had been available for 1973, it appears that this variable would have shown an even higher t-stat and the model would have explained a few more percent of the variance in outcomes.

physicians per capita, all other things being equal, result in greater competition for patients and increased pressure on individual physicians to participate in new economic institutions.[122]

The strong statistical association is consistent with the hypothesis. It suggests that, in the mid 1970s, MDs in such cities responded to competitive pressures by contracting with HMOs. With an adequate physician network in hand, many of these HMOs were able to successfully market their health plan to employers and consumers.[123]

B5 NURSES IN THE FINAL 1970s MODEL

The finding that the supply of nurses, specifically RNs, also had a statistically significant association with HMO growth is without precedent in the published literature.

The result for the supply of nurses is comparable with the result for physician supply, both conceptually and in terms of the magnitude of the effect.[124] However, the mechanism by which the relative supply of RNs is likely to have influenced HMO growth is less clear than it is with the 2 physician variables. Nurses were (and are) a significant component of the direct and indirect workforce employed by HMOs. But the employment of nurses, in any role, has not been seen as a substantial bottleneck for HMO growth.[125]

If supply of nurses influenced HMO growth, there are several possible explanations. One plausible hypothesis is that the nurse labor market influenced the ability of HMOs to negotiate favorable contracts with hospitals. At that time, a very high percentage of nurses worked for general hospitals, and, conversely, a high percentage of hospital employees were RNs.

HMOs achieved some of their cost advantage by reducing rates of hospitalization for their enrollees (Luft 1978). Many HMOs have also been able to negotiate favorable rates from hospitals in spite of their lower utilization of such facilities (Melnick et al 1992). It may be that hospitals in nurse surplus areas were able to extract surplus from nurses in the labor market only to find HMOs were able to extract some or all of that surplus in the hospital services market.[126]

---

122 Findings that areas with more physicians have higher medical expenditures and corresponding hypotheses of induced demand do not nullify this principle. Even if physicians in such areas collectively succeeded in upholding high levels of demand and expenditure, some or all of them may still face increased pressure to take unusual steps to generate high incomes.

123 As discussed in Chapter 1, until the 1970s the A.M.A. and other physician organizations had actively opposed, and to some extent suppressed, the HMO movement. However, by 1973, when the federal HMO act was passed, medical organizations were forced to accept the existence of HMOs in an increasing number of cities and states. The prior opposition to HMOs may have contributed to pent up pressure for HMO expansion and accentuated the HMO-positive effect of physician concentration in the 1973-78 period.

124 If the number of MDs per 100 population increased by .036 (1 SD for this population of MSAs), the expected increase in HMO enrollment would go up by .76%, or 7,600 enrollees in an MSA of 1,000,000. For RNs, the comparable SD is .101 per 100 population, and a corresponding increase in their numbers would yield a corresponding jump in HMO enrollment of .93% or 9,300 enrollees in an MSA of 1,000,000. Please see the calculations and examples provided in Appendix E. When both physician variables are considered, it appears that physician attributes did have a much greater effect on enrollment growth than did nurse attributes.

125 For example, LD Brown (1983) discusses HMOs' need for support from physicians and physician controlled organizations (such as medical schools) at length but fails to mention the need to recruit nurses.

126 Jim Dertouzos discussed the view that institutional arrangements are designed to extract surplus in imperfect markets in his RGS Micro-economics II class. But why do direct measures of hospital resources and utilization appear to have little or no effect on HMO growth during this period?

Another hypothesis is that nurses assisted the growth of HMOs in capacities other than as hospital employees. They may have taken additional clinical responsibilities in the offices of HMO affiliated physicians, or they may have directly worked for HMOs in administrative or marketing functions. It is unlikely that large numbers of nurses served in either of these ways. But in slack markets, a small number of nurses of superior ability may have abandoned traditional nursing career tracks to participate in the HMO movement. If so, these nurses could have boosted fledgling HMOs during their very sensitive initial years.

Lastly, nurses may have been as influential as consumers as they were as employees. Besides usually making health insurance decisions for their families, they may have influenced many employer insurance decisions and been opinion leaders in their cities. Unfortunately, little evidence is available concerning the attitudes of most RNs toward HMOs during this period.

In any case, the hypotheses presented here are not mutually exclusive. It may be that the nurse effect was produced by some combination of these factors and possibly other factors still to be considered. The hypothesis of nurse labor market influencing the "downstream" hospital services market seems to have the most evidence in its favor. This hypothesis is also the most likely to be testable using available data.

B6 LATITUDE IN THE FINAL 1970s MODEL

Like the relationship with nurse supply, the relationship between geographic Latitude (position along the North-South axis) and HMO growth has not been investigated in any published study.[127] In the final model this variable generated a t-statistic of 3.15, easily passing the standard test of statistical significance. When included in a variety of regression specifications, Latitude always showed a statistically significant association when the Group Practice, MD and RN variables were also included.

However, the Latitude finding does not reflect a structural effect; Latitude is included in the analysis as a control variable. It is not possible to change a city's latitude without changing its fundamental identity. Therefore it is not meaningful to speak of a city's latitude, in isolation, generating a causal effect on other city attributes.

In addition to Latitude serving only as a control variable, there are additional reasons to apply caution in describing the statistical relationship between Latitude and HMO growth during the 1973-78 period. First, Latitude showed virtually no association when analyzed within the context of single and double regressions. Secondly, it is unclear why Latitude per se would have an association with HMO growth. Thirdly, there may be some confounding between Latitude and Firm Size. These 2 variables have a positive correlation of +.38, and separating their effects within this data set is challenging.

---

It may be that hospital statistics included in this analysis do not effectively reflect the degree of tightness or market power in these markets. But the RNs per capita measure may accurately portray conditions in the nursing market. And nurse market conditions could have influenced the ability of HMOs to negotiate favorable contracts with hospitals.

[127] Of course, it has been frequently noted that HMOs first reached prominence on the West Coast and that the movement spread to other parts of the country.

Fourthly, as shown in Table 4-7, the magnitude of the Latitude coefficient is not robust across different regression specifications. Fifthly, the coefficient and the corresponding t statistic are not robust to incremental changes in the composition of the data set. As pointed out in Section C of this chapter, removal of Honolulu reduces the Latitude t-statistic from 3.15 to 2.06.

Firm Size shows a statistical association with HMO growth in a number of model specifications, including one with Group Practice, MDs and RNs.[128] But when Latitude is thrown in with the same 1st 3 variables, it definitely shows superior explanatory power. Furthermore, when both variables are included in the same regression, the statistical association with Latitude remains strong while the statistical association with Firm Size shrinks considerably.

The process of operationalizing Firm Size presented substantial conceptual issues and measurement problems. In a word, the estimates are fuzzy. But Latitude is a very straightforward concept, and the estimates included here are more than sufficiently accurate for the purposes of this study. It may be that if Firm Size were better conceptualized and more accurately measured, then regression analysis would show that it produces most or all of the statistical relationship attributed to Latitude.

However, Latitude may be highly correlated with a set of economic variables other than Firm Size. These variables relate to attractiveness of various locations to workers and firms. During the 1970s, the long-term shift of economic development from the Northeast and Midwest to the Southeast and Southwest was at its height. Workers were attracted southward by mild weather, and firms were attracted by the lower wages that usually prevailed in southerly areas. These 2 economic effects compounded each other. This overall phenomenon appears to have spurred innovations in labor relations, working conditions and employer benefits. Therefore, Latitude may reflect a broad set of economic conditions that influenced the growth of HMOs.

The negative statistical association between Latitude and HMO growth only came through after Group Practice, MDs and RNs were controlled for in the regression equation. The RNs variable has a positive correlation of .58 with Latitude, meaning that nurses tended to be much more concentrated in northerly cities; MDs has a positive correlation of .27 with Latitude. It appears that the HMO growth effect of these concentrations of providers in northerly cities masked the negative association with Latitude in single and double regressions.

B7 FINAL 1990s MODEL

Table 4-9 shows the final result of the 1990s regression program. A model using Economic Growth from 1978 to 1993, Group Practice, MDs per capita and the East Midwest dummy variable was chosen to explain growth in HMO market share. The remarkable aspect of this result is that the effects of Group Practice and MDs are in the opposite direction from those found for the mid 1970s period.

---

[128] The regression with Group Practice, MDs, RNs and Firm Size generated an Adjusted R2 of .58 with Firm Size yielding a t-statistic of -1.94, not quite statistically significant.

# TABLE 4-9
# FINAL 1990s MODEL
# FOR GROWTH IN HMO MARKET SHARE

ANOVA Table and t Statistics:

ANOVA TABLE

| SOURCE | SS | df | MS | N: | 75 |
|---|---|---|---|---|---|
| Model | 858 | 4 | 214.55 | F(4,41) | 6.38 |
| Residual | 2,354 | 70 | 33.63 | Prob > F | 0.0002 |
| Total | 3,212 | 74 | 43.41 | Adj $R^2$: | .23 |
| | | | | Root MSE: | 5.80 |

***t Statistics***

| Explanatory Variable | Coeff. | t Value | P Value |
|---|---|---|---|
| Economic Growth | -7.68 | -3.16 | 0.002 |
| % Physicians in Group Practice | -.153 | -1.93 | 0.058 |
| MDs per capita | -22.05 | -1.94 | 0.057 |
| E Midwestern Location | -4.59 | -2.30 | 0.024 |
| Intercept | 26.75 | 5.31 | 0.000 |

NOTE: Unit used to develop ANOVA table is Percentage Point Growth of MSA population enrolled in HMOs at MSA level from 1988 to 1993. The 5.80 Root Mean Square (RMS) value displayed at the lower right corner of ANOVA table means that the model predicts growth in HMO market share with a standard error (SE) of 5.80%. This value should be compared with the SD of HMO market share growth of 6.59%.[129]

---

All of the explanatory variables in this model have a negative association with HMO growth.[130] This specification yields an adjusted $R^2$ of 23%, the highest value of any regression tried with Economic Growth and 3 other explanatory variables.[131] This $R^2$ value is far lower than was achieved for the 1st period, and these results are less satisfying than those for the 1970s. However, this lower $R^2$ applies to a data set with much higher variance in terms of HMO market share and especially in terms of numbers of HMO enrollees.

To explain this result in terms of HMO enrollment, the 1990s model enables an analyst to reduce the Standard Deviation of the outcome variable of 6.59% to a Standard Error of 5.80%. For an MSA of 1.2 million people, a naive analyst would apply the average growth of

---

[129] Technically, 6.54%, please see footnote to Table 4-6.

[130] Technically, the population standard deviation for HMO market share growth for the 1988-1993 period is 6.54%. As was the case with the 1970s analysis, the minute difference in the computation of the standard deviation does not warrant transgressing conventional presentation.

[131] For quadruple regressions including Income an adjusted R2 as high as 23% was also generated. But, as explained in Section B1 of this chapter, Economic Growth is preferred as an explanatory variable.

3.78%, or an increase of 45,360 HMO members. Because of the Standard Deviation of 6.59%, or 79,080 members, the analyst could have little confidence in this estimate.

With the assistance of the 1990s model, the analyst would use the MSA values for Economic Growth, Group Practice, MDs and the East North Central dummy to generate a different estimate, let's say an increase of 75,000 members. The applicable Root Mean Squared Error (RMSE or s) is 5.80%, or 69,600 members. Since the construction of a 95% confidence interval involves the addition or subtraction of 2 Standard Errors, the knowledgeable analyst would still have little confidence in saying whether HMO enrollment grew or shrunk in this hypothetical city.

B8 FINAL 90s MODEL AND ALTERNATIVE SPECIFICATIONS

The 1990s data set includes 75 observations, noticeably more than the 46 used for the 1970s. However, 75 observations still provides a serious constraint on the number of independent variables that can reasonably be used in regression analysis. The final 1990s model uses 4 explanatory variables, the same number as the 1970s model. As with the 1970s model, a large number of regression specifications were tested.

Table 4-10 serves the same purpose for the 1990s analysis that Table 4-7 served for the 1970s analysis. Table 4-10 provides a comparison of variable coefficients across up to 3 different specifications. The table includes results from 23 single regressions, and it repeats material from Table 4-9 concerning the final 1990s model. The last part of Table 4-10 shows results from a regression using the Stata Stepwise algorithm.[132]

Table 4-7 did not show the 3 explanatory variables that were not available for the 1970s analysis, and Table 4-10 does not show the 2 variables that are not available for the 1990s analysis. The meticulous reader will notice that variable numbers 9 and 13 are missing. As with Table 4-7, Table 4-10 shows coefficients, t values and $R^2$ values for single regressions, the final model and the stepwise model. The $R^2$ values for the final and stepwise models are shown in a separate row below the listed variables.

The 2 physician related variables included in the final 1990s model show reasonably consistent coefficient values across the 3 specifications. The coefficient for MDs per capita ranges from –21.5 to –26.2, and the coefficient for Group Practice ranges from -.153 to -.225.[133] The Economic Growth variable shows very similar coefficients in the single regression and the final model, but this value decreases by more than 80% in the stepwise model. As discussed above, in the 90s data set, it is very difficult to distinguish between effects caused by Economic Growth and effects caused by per capita Income per se.[134]

---

[132] Stata Corporation, Reference Manual, op cit. The method used for the 1990s was slightly different from that used for the 1970s. For the 1990s ***all*** Stata default parameters were used, including the default for fenter, the F value for variable entry. This default value is .5.

[133] It appears a curious coincidence that the effects of the Group Practice and MD variables reversed direction from the 1970s to the early 1990s, but their order of magnitude consistently remained within the same range.

[134] Examination of correlations between Economic Growth and the other variables included in the 1990s Stepwise Regression does not suggest that any of these 9 variables individually had a major effect on the Economic Growth coefficient. But the collective inclusion of several of these variables may have substantially contributed to its decrease.

# TABLE 4-10
# COMPARISON OF VARIABLE COEFFICIENTS ACROSS MODEL SPECIFICATIONS
1990s Analysis

| # | Variable | Single Regressions | | | Final Model | | Stepwise Model | | Variable |
|---|---|---|---|---|---|---|---|---|---|
| | | Coefficient | t-statistic | Adjusted $R^2$ (%) | Coefficient | t-statistic | Coefficient | t-statistic | (abbrev.) |
| 1 | Hospital Beds per capita | -9.70 | -1.38 | 1 | | | | | Beds |
| 2 | MDs per capita | -21.5 | -1.71 | 3 | -22.0 | -1.94 | -26.2 | -1.56 | MDs |
| 3 | RNs per capita | -3.16 | -.65 | 0 | | | | | RNs |
| 4 | LPNs per capita | -23.9 | -1.82 | 3 | | | -32.1 | -1.75 | LPNs |
| 5 | Pharmacists per capita | -17.1 | -.41 | -1 | | | | | Pharms |
| 6 | Hospital Days per capita | -.031 | -1.19 | 1 | | | .0613 | -1.53 | H Days |
| 7 | Hospital Expenditures per capita | -.92 | -2.57 | 7 | | | | | H Spend |
| 8 | Hospital Costs per day | -.273 | -.05 | -1 | | | | | H Costs |
| 10 | Proportion MDs Aged 45-64 | 42.5 | 2.30 | 5 | | | 10.34 | .408 | MD-Mid |
| 11 | Proportion of FPs/GPs | -6.80 | -.37 | -1 | | | | | FP/GP |
| 12 | % Physicians in Group Practice | -.212 | -2.57 | 7 | -.153 | -1.93 | -.225 | -2.34 | Group P |
| 14 | Age of Oldest HMO | .023 | .41 | -1 | | | | | Age HMO |
| 15 | Per Capita Income # | -.0011 | -3.46 | 13 | | | -.00059 | -1.38 | Income |
| 16 | % Economic Growth | -7.71 | -3.10 | 10 | -7.68 | -3.16 | -1.42 | -.39 | Ecn Gr |
| 17 | Employees per Establishment | -.555 | -1.49 | 2 | | | -.398 | -.929 | Est. Size |
| 18 | % Workers Union Members | 15.2 | 1.37 | 3 | | | -6.91 | -.495 | Union |
| 19 | Population Density | .00017 | -.08 | 1 | | | | | Pop Dens |
| 20 | % Population Growth | .016 | .01 | -1 | | | | | Pop Gr |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 21 | Net Migration | -.462 | -.72 | -1 | | | | | Mig |
| 22 | Average Schooling | -1.01 | -.46 | -1 | | | | | Educ |
| 23 | 8 Regional Dummies | -3.75 to 4.17<br>EMidW: 2.43 | -1.23 to 1.90 | -1 to 3 | EMidW # -4.59 | EMidW # -2.30 | | | 8 Dum |
| 24 | Relative Latitude* | 1.54 | 1.04 | 0 | | | 3.7 | 1.89 | Lat. |
| 25 | Relative Longitude* | 43.5 | .90 | 0 | | | 33.0 | .520 | Long. |
| | | | | | | | | | |
| | Number of Explanatory Variables | 1 | | | 4 | | 11 | | |
| | Adjusted $R^2$ (in %) | | | -1 to 13 | 23 | | 21 | | |

Notes: * Coefficients listed for Relative Latitude and Longitude are the actual regression coefficients multiplied by $10^5$ (100,000).

The 4th explanatory variable in the final model, East Midwestern location, is a control variable for the same reason that Latitude is a control variable in the 1973-78 analysis. It is not possible to change a city's east Midwestern location without changing the city's identity, so it is not meaningful to discuss east Midwestern location, by itself, as a causal factor in the determination of other city attributes.

Additionally, east Midwestern location shows little consistency in coefficient value. In single regression, it generated a coefficient of –2.43, and the magnitude of this value increased to –4.59 in the final model. However, East Midwestern location was not included in the Stepwise model, indicating it added little predictive value in numerous tests by the Stata Stepwise algorithm. It seems unlikely that coefficients as high in absolute value as –4 or even –3 were generated in any of the stepwise runs. Therefore, this variable cannot be said to show a robust effect.

As before, several variables not included in the final model show inconsistent results between single regression and stepwise model. In single regression, Hospital Expenditures per capita showed an effect of -92 with a t-statistic of -2.57, but it was not included in either the final or stepwise model. For example, when this variable was included in a triple regression with Economic Growth and Group Practice (not shown in Table 4-10) the coefficient went down to -.065. The Proportion of MDs Aged 45-64, another promising variable in single regression, was included in the stepwise model, but the coefficient went down from +42.5 to +10.34.

## B9 EXPLANATORY VARIABLES IN THE FINAL 1990s MODEL

*Economic Growth*

The explanatory variable in the final 1990s model with the highest absolute t value is Economic Growth. This variable yielded a t-statistic of -3.16, and when it was applied in a single regression it generated an adjusted $R^2$ of over 10%.

As discussed in section B3 of chapter 3, economic growth was hypothesized to have a negative effect on HMO growth from 1988 to 1993 because cities with rapid economic growth had seen the most rapid growth during the 1970s into the 1980s.[135] When the HMO bust took place from 1987 to 1990,[136] these cities were more likely to have unstable HMOs being run with poor management practices.

It appears that rapid economic growth rapidly shifted from being a favorable factor for HMOs to becoming a cause of declining enrollment or at least slower growth. Conversely, HMOs continued to grow at a healthy rate in more stable cities because the boom and bust dynamic applied much less and because underlying health economic factors continued to be favorable to HMOs. It is not known whether cities with high economic growth continued to experience lower rates of HMO growth beyond 1993.

---

[135] Unfortunately, Economic Growth was not tested as an explanatory variable for the 1st period, but a positive effect of Economic Growth may be associated with the negative effect of Latitude.

[136] The bust was triggered by premium wars in 1986 and Maxicare's report of $256 million in losses in 1987. Although national HMO enrollment kept growing slowly from 1987 to 1990, over 200 HMO plans went bankrupt, merged out of existence or lost membership. See Appendix F, Generation of Expected Results, for more information.

*Physician Variables*

Two of the other variables included in the final 1990s model also present paradoxical results. Both Group Practice and MDs per capita were included in the final 1970s model, and their associations with HMO enrollment growth were clearly positive, in the case of Group Practice overwhelmingly so. But in the 1990s model, these associations are negative.

The negative associations of the 1990s are not as strong, either in terms of t-statistics or of numbers of enrollees, as the positive associations of the 1970s.[137] The negative Group Practice association is robust to a wide variety of specifications. The negative MDs per capita association is also robust to several specifications, but it is not robust to the composition of the data set. As pointed out in Section C of this chapter, removal of Raleigh-Durham reduces the t statistic for MDs per capita from –1.93 to -.62, with a corresponding reduction in the size of the coefficient.

Why would the Group Practice variable swing from a very strong positive association to a highly likely negative association? And why would the MD variable shift from a strong positive association to a possible negative association? Assuming that these associations do in fact reflect causal effects, there appear to be 2 classes of explanations. The first class of explanations is very specific to changes in HMOs' relationships with physicians. The second class of explanations is much more general and flows out of the diffusion of innovations framework presented in Chapter 1. Both classes of explanations may have some validity.

In order to develop the first class of explanations, it is desirable to begin with the evolution of HMOs from 1973 to 1993. During this period, most HMO enrollment shifted from non-profit group based plans to for profit Independent Practice Associations (IPAs) with increasingly broad physician networks.

Whereas group practice physicians in the 1970s may have felt that HMOs offered an essentially friendly and familiar form of management, group practice physicians in the 1990s may have seen HMO supervision as an intrusion on their collegial and collaborative practice style. Another hypothesis is that physicians started going into group practice to improve the financial viability of their practices, and that group practices were in a better position to avoid contracting with HMOs or taking large numbers of HMO patients. Concerning the MD variable, it is possible that physicians in cities with higher concentrations of MDs were better organized or more motivated to resist HMO growth on a covert or implicit basis.

The second class of explanations is not specific to HMOs or even to the health sector. The diffusion of innovations literature (Rogers 1995, LA Brown 1981) long ago established that early adopters of an innovation differed in several respects from later adopters. For example, one major study found that the very first group of Iowa farmers who started using hybrid corn had more formal education than those who started later (Rogers 1995, 33). Such findings were usually based on analysis using individuals or households as the unit of analysis, but similar analysis has been applied both to organizations and to cities (LA Brown 1981, 152-175).

---

[137] For example, if a state's percentage of group physicians increased by 18% (or 2 standard deviations in the 1990s data set), then, all else being equal, a city of 1.2 million in that state would experience a decrease in HMO market share of 2.75%, or 33,000 fewer enrollees

Applying the results of this study to the diffusion of innovations framework, MSAs that grew more rapidly from 1973 to 1978 are the early adopters, and MSAs that grew more rapidly from 1988 to 1993 are the later adopters. The early adopter cities had a greater need or predisposition toward HMO insurance. Under this reasoning, it was only after enrollment growth in the early adopters had begun to level off that enrollment began to grow rapidly in the later adopter cities. In this context, it is natural that that the later adopters have different attributes, such as different physician population attributes, than the early adopters. Whether by conscious design or the invisible hand, HMO establishment, marketing and sales efforts were shaped by this underlying dynamic.

Such a view is completely consistent with the product life cycle concept referenced by LA Brown (1981). The HMO insurance product approached maturity in the early adopter cities while it was still in the early part of the growth stage in the late adopter cities. (The implications of product life cycle analysis for the HMO movement as a whole and for its future are explored further in Chapter 5, Conclusions). However, one key premise of this reasoning is that HMO insurance could approach or reach maturity in geographic areas well before enrollment of 100% of the population would be reached.[138]

*Eastern Midwest Dummy Variable*

The final statistical finding for the 1990s is that location in the eastern Midwest, in the states of Ohio, Indiana, Illinois, Michigan and Wisconsin,[139] had a negative relationship with HMO growth during this period. On average, market share in these MSAs grew by 4.6% less than would otherwise be expected. As is indicated above, this variable is considered to be a control variable. Since the coefficient was not robust to other specifications, even inclusion as a control variable can be questioned. However, this statistically significant finding is worthy of some discussion.

The data provide a few suggestions as to why this region was particularly unfavorable for HMO growth during this period. In 1988, the average market share for the entire data set was 16.8%, and the average market share in the eastern Midwest was 19.9%. But by 1993, eastern Midwestern cities had an average market share of 20.4%, just slightly below the average of 20.6%. HMO enrollment in this region was stagnant while the rest of the country, on average, experienced substantial growth.

If the eastern Midwest dummy is excluded from the regression, the resultant model (using Economic Growth, Group Practice and MDs as explanatory variables) would expect substantial growth in this region, primarily because of the Economic Growth variable. The eastern Midwest shows lower than average economic growth during the 1978-93 period, and the model shows that lower economic growth would lead to higher HMO growth during this period. This relationship didn't hold in this region.

A possible explanation is that HMO marketers, in the boom phase, worked aggressively to increase enrollment in the eastern Midwest. They disregarded the low economic growth of the

---

138 This premise is supported by the findings of Kemper et al (1999/2000) and discussed in Chapter 2 of this report.

139 The 11 MSAs in the data set in this region are Chicago, IL, Indianapolis, IN, Detroit and Grand Rapids, MI, Cincinnati, Cleveland, Columbus, Dayton, Toledo and Youngstown, OH, and Milwaukee, WI.

region,[140] and treated it pretty much the same way they treated the Northeast - as prime territory for HMO expansion. This explains why the eastern Midwest was above average in HMO enrollment in 1988.

However, because of the previously low economic growth, and possibly because of other factors not captured in the model, eastern Midwestern HMOs had even less support and stability than HMOs throughout the country. Therefore, when the HMO bust struck, this region was particularly affected. The big picture is that, in most of the country, the 1988 to 1993 period saw HMO infill and recovery from the HMO bust. But the eastern Midwest may have been out of phase, and the false success of the 1980 to 1987 period seems to have delayed, rather than accelerated, the growth of HMOs there.

[140] In fact, by 1993, the Midwest was growing faster than the rest of the country and was already enjoying the overall economic boom of the 1990s.

## C. Regression Diagnostics

Analysis of residuals was undertaken to test regression assumptions and to identify influential points. Diagnostic methods included visual inspection of residual plots and generation of fitted values, residual values, studentized residual values, Cook's distances and DFbetas. This diagnostic analysis showed that both of the chosen models are sound and appropriate.

Residual plots for the final 1970s and 1990s models are shown and discussed in Appendix B. Table 4-11 shows observations for both periods with noticeable values of Cook's distance. Cook's distance is an overall measure of the influence of individual observations on the results of a specific regression. With multiple regression, Cook's distance by itself does not indicate the extent to which specific variable coefficients were influenced by different observations.

Authorities disagree on what value of Cook's Distance, or $D_i$, warrants attention and analysis. Applied Linear Regression states "If the largest $D_i$ is substantially less than 1, deletion of a case will not change the estimate of (the matrix) Beta by much."[141] By that standard, all of the observations in both sets of final analyses fit well within the model. On the other hand, the Stata Manual states "... values of Cook's Distance greater than 4/n should also be examined."[142] This would imply a critical value of .087 for the 1970s analysis and a critical value of .053 for the 1990s analysis.

Table 4-11 uses a relatively tight standard of .10 for Cook's D. Those observations with greater values are listed and explained. However, based on the examination of residuals, it appears clear that those observations with Cook's D of less than .20 (5 out of the 7 cases listed) do not exert remarkable influence. The 2 cases that generate Cook's distances of greater than .20 both occur with the 1990s model. Raleigh-Durham (R-D) is a tremendous high outlier for the 1989 MDPC variable ($z = 4.5$), possibly because it has a very large concentration of medical residents in only a medium sized urban area. It also had one of the greatest declines in HMO market share during the 1988-1993 period; HMO enrollment dropped by over 15% of the population.

It is not surprising that Raleigh-Durham is a very influential point, with a Cook's distance of .375, and that almost all of its influence is exerted on the MD variable. If Raleigh-Durham were removed from the data set, the t-statistic for the MD variable changes from -1.93 to -.62. Without Raleigh-Durham, there is no MD effect in the 1990s. It was not dropped from the analysis because the data seem to be reasonably accurate, and it is possible that the physician concentration in the city was connected with the dramatic drop in HMO market share.[143] However, these diagnostic results considerably weaken confidence in a possible MD effect on HMO market share during this period.

---

141 Weisberg, Sanford, Applied Linear Regression, Wiley, 2nd ed., 1985, p.120.

142 Stata Corporation, Reference Manual, Stata Press, Release 4, 1995, p.393. This source references Bollen and Jackman "Regression Diagnostics: An Expository Treatment of Outliers and Influential Cases" in Modern Methods of Data Analysis, Sage Publications, 1990, pp.257-291.

143 Arguably, the concentration of medical residents in this MSA is largely irrelevant to HMO enrollment, so that R-D's large contribution to the MD effect would be artifactual. But it could also be that residents, like RNs in the 1970s, did influence the economic conditions of HMOs. Additional data on the nature of the physician workforce in R-D and a better understanding of the drastic decline of the HMO industry in this MSA could clarify this issue.

## TABLE 4-11
## REGRESSION DIAGNOSTICS:
## CASES WITH COOK'S DISTANCE > .100

*For Both Analysis Periods; In Descending Order*

| # | MSA | Cook's D | Reason for High Value | Analysis |
|---|---|---|---|---|
| ***Final 1970s Model*** | | | | |
| 1 | Honolulu | .174 | Influential Point. Neg Outlier for Latitude and High Value for Group Practice. | When Honolulu is taken out of dataset, t-stat for Latitude changes from -3.15 to -2.06. |
| 2 | Omaha | .150 | 2nd Highest Value for RNs and only moderate HMO Growth. | When Omaha is taken out, t-stat for RNs rises from 3.71 to 4.47. |
| 3 | Las Vegas | .136 | Decline in HMO enrollment and lowest value for MDs. | When Las Vegas is taken out, t-stat for MDs drops from 3.56 to 3.03. |
| 4 | Seattle | .116 | Moderately high values for Outome and 2 Explan Vs. | With Seattle out, t-stat for Lat. changes from -3.15 to -3.65. |
| | | | | |
| ***Final 1990s Model*** | | | | |
| 1 | Raleigh-Durham(R-D) | .375 | A terrific Outlier (high) for MDPC, and the greatest shrinkage in HMO Enrollment of any MSA during this period. | When R-D is taken out of Dataset, t-stat for MDs per capita changes drastically from -1.93 to -.62. |
| 2 | Indnpls | .210 | Shows the greatest shrinkage in HMO Enrollment of any E Midwest MSA during this period. | When Indianapolis is taken out, t-stat for E North Central Dummy changes from -2.30 to -1.39. |
| 3 | Dayton | .150 | An E Midwest MSA w Substantial HMO Growth. | Take out Dayton and E North Central t-stat changes from -2.30 to -3.04. |
| | | | | |

# As shown in Table 4-9, the Dummy variable for East Midwestern location is included in the final 1990s model.

For the early 1990s data set, the other prominent influential point is Indianapolis, with a Cook's distance of .210. In this case, the influence is largely on the coefficient for the eastern Midwest dummy variable. Indianapolis, an east Midwestern city, showed the greatest decline of HMO market share of any MSA in the data set, and it contributed disproportionately to the negative effect the dummy variable showed. If Indianapolis is removed from the data set, the t-statistic for this variable would change from -2.30 to -1.39.

Indianapolis clearly qualifies as an influential point, but the evidence still favors the existence of an east Midwest effect. After all, Indianapolis is in the east Midwest, and the evidence of a substantial drop in HMO market share there is strong. Additionally, another 1990s outlier, Dayton,[144] suppresses the size of this estimated effect. If Dayton alone were to be dropped from the data set, the t-statistic of the east Midwest variable would jump (so to speak) to -3.04. If both Indianapolis and Dayton were taken out, the final 1990s model would yield an adjusted R2 of 22% and the east Midwest dummy variable would show a t-statistic of -2.10.

[144] Dayton is the last entry in Table 4-9 with a Cook's distance of .150.

## D. Chapter Summary

Section A presents descriptive statistics for both the outcome and explanatory variables. In general, these variables are distributed in a fairly symmetric manner and do not have many outliers. They are suitable for the application of ordinary least squares regression analysis.

The primary purpose of this chapter is to present the results of the regression analysis; this is done in Section B. The final 1970s model is presented and explained in detail; then the same is done for the final 1990s model.

The final 1970s model explains growth in HMO market share as a function of 4 explanatory variables, the percent of physicians in group practice, MDs per capita, RNs per capita and relative latitude. The percent of physicians in group practice shows the strongest statistical relationship, and it is the most important explanatory variable. This result is strong evidence that physicians in group practice were more open to the HMO style of practice and more willing to join HMOs during the 1973-78 period. The statistical relationship between MDs per capita and HMO growth supports the hypothesis that a higher concentration of physicians led to greater competition between them and, consequently, more willingness to participate in new economic institutions, such as HMOs.

The finding that the concentration of nurses shows a statistically significant association with HMO growth was not expected or precedented. There are several possible explanations for this finding. One possibility is that conditions in the nurse labor market influenced hospitals' competitive position and consequently influenced negotiations and arrangements between hospitals and HMOs.

The relationship between latitude and HMO growth cannot be a causal relationship because it is not possible to change a city's latitude without changing its basic identity. However, latitude is included in the final model as a control variable. Latitude may serve as a proxy variable, representing factors related to firm size, labor market conditions or other explanatory variables that are difficult to measure accurately.

The final 1990s model also includes 4 explanatory variables, but the statistical relationships are markedly weaker. The astonishing aspect of the 1990s results are that the physician related explanatory variables from the 1970s analysis show evidence of a statistical relationship in the opposite direction. Both percent of physicians in group practice and MDs per capita show a negative association with HMO growth for the 1988-93 period. However, for both these variables this negative association falls just short of statistical significance.

The 3rd variable included in the final 1990s model is economic growth, which shows a statistically significant negative association with HMO growth. The final variable in this model is Eastern Midwestern location (i.e. location in the states of Ohio, Indiana, Illinois, Michigan or Wisconsin), which shows a barely statistically significant negative association.

The most important conclusion from the 1990s analysis is that the relationships seen for the 1970s definitely did not prevail in the early 1990s. In fact the 2 key relationships between physician variables and HMO growth may have reversed direction. The dynamic of HMO

growth changed between the 1973-78 period and the 1988-93 period. Perhaps the best way of explaining this is to suggest that the HMO insurance product was in a different stage of its life cycle by the early 1990s. The implications of this suggestion are explored in Chapter 5, Conclusions.

Section C presents regression diagnostics for the final 1970s model and the final 1990s model. Residual plots, Cook's distance and other statistics are used to test regression assumptions and identify influential points. This analysis raises some interesting points, but it does not refute the statistical assumptions. None of the major findings are dependent on one specific observation.

In overall summary, this analysis finds strong positive relationships between HMO growth and 2 physician variables for the 1973-78 period. There was also a strong positive relationship between the concentration of nurses and HMO growth. For the1988-93 period, there is no evidence of these relationships. These results strongly suggest that the nature of HMO enrollment growth at the MSA level changed between the 2 periods. Chapter 5, Conclusions, will further address the interpretation and evaluation of the final models for both periods. It will address implications for policy, and it will place the results within the context of the literature on the economics of HMOs.

## Chapter 5: CONCLUSIONS

"At your age the heyday in the blood is tame, it's humble."
Shakespeare (Hamlet to Gertrude)

This chapter consists of Basic Conclusions, Policy Analysis and Technical Conclusions. After summarizing the statistical findings, Basic Conclusions places the results within the diffusion framework presented in Chapter 1. Policy Analysis discusses broad policy implications, specific policy issues and the future of HMOs. Technical Conclusions compares the findings with the prior expectations and with the results of previous studies. The methodological implications of this study are briefly discussed, and numerous suggestions for further research are offered. A brief Chapter Summary concludes this chapter and the main part of this study.

### A. Basic Conclusions

A1. RESEARCH FINDINGS

The regression analysis of HMO growth in the 1973 to 1978 period shows a connection between provider variables and HMO growth. As discussed in Chapter 4, MD and RN variables show strong explanatory power when HMO enrollment growth in cities that had operational HMOs in 1973 is analyzed.

A local tradition of the group practice of medicine appears to have been especially favorable for HMO growth. On the MSA level, an increase in the number of physicians in group practice by 1% of the physician population is associated with a .17% increase in overall HMO market share.[145] The congruence between group practice and HMO management during this period may be responsible for this relationship. The overall proportion of MDs in the population also generated a statistically significant positive association. It appears that increased competition for patients drove many physicians to affiliate with distasteful HMOs. Although these 2 relationships reflect distinct mechanisms, together they suggest that MD acceptance was essential.

The overall proportion of RNs in the population is positively associated with HMO growth during the mid 1970s. This may have been a consequence of surplus value being transferred from nurses to hospitals to HMOs, and other attributes of nurses may have contributed to it. We also see that HMOs tended to grow more rapidly in MSAs of lesser Latitudes, i.e. more southerly cities. The most likely explanation for this unprecedented finding is that Latitude is a proxy for Firm Size or other economic variables that are difficult to measure directly.

Numerous hypothesized variables do not show any relationship with HMO growth during the 1973-78 period. No direct measure of any hospital attribute shows any relationship. Available measures of Per Capita Income, market power of Blue Cross plans and several other variables showed no effect.[146]

---

[145] In a hypothetical city with 1 million people and 1,500 MDs during this period, an increase of 15 MDs in Group Practice in 1975 is associated with an increase of 1,700 HMO members from 1973 to 1978.

[146] Table 4-7 lists the 25 variables that were tested and provides a quick summary of findings for each.

Regression results for the period 1988 to 1993 are weaker, both in terms of statistical significance and of material relationships with HMO growth. Once again, most of the hypothesized relationships are not remotely borne out by statistical testing. However, there is an extraordinary suggestion that the proportion of Group Practice MDs and the number of MDs per capita actually had a negative effect on growth during the later period.[147] There was also a finding that Economic Growth had a negative association with enrollment growth during this period, also an initially surprising finding.[148]

A2 FINDINGS WITHIN THE DIFFUSION FRAMEWORK

In Chapter 1, an applicable framework on the diffusion of innovations was reviewed. Based on the work of Lawrence A. Brown, this framework uses 6 elements to define the process and extent of diffusion. It offers 4 categories of factors that influence the establishment of diffusion agencies and the success of the diffusion; these categories are market potential, public exposure, agency characteristics (in this case characteristics of individual HMOs) and the role of other institutions. Brown also incorporates product life cycle stages from the marketing literature, namely introduction, growth, maturity and decline. Product life cycle fits in well with this literature because it illustrates how successful diffusion strategies can, and often do, change over time.

Chapter 1 showed that the research design of this study is consistent with Brown's framework. In particular, the conduct of parallel statistical analyses for 2 time periods separated by 15 years allows for possible advancement of the HMO product and industry from one life cycle stage to another. It was noted that the explanatory variables employed in this study primarily relate to the categories of market potential and role of other institutions.

The role of other institutions receives particular attention because HMO relationships with physicians have always been crucial to the success of the industry. However, the physician relationship issues that (mostly) fledgling HMOs faced in 1970s were very different than those that faced many large and growing HMOs in the 1990s. MDs per capita and 4 other physician workforce variables were hypothesized to affect the rate of HMO growth on the MSA level.

Chapter 2 discussed how the diffusion of innovation literature relates to literature on the economics of HMOs. Specifically, the health economics concept of favorable and adverse selection relates to the adopter categorization system. Typically, diffusion researchers classify the very first adopters of an innovation as "innovators" and those who adopt well ahead of the majority as "early adopters." Although the concept of selection is different in several respects, the adopter categorization system provides a helpful analogy for understanding why the evidence indicates that favorable selection is less of a factor behind HMO cost savings than it may have been in the 1970s and 1980s.

Chapter 2 also discusses findings from the late 1990s that HMO enrollees disproportionately tend to be willing to trade off provider choice for health care cost savings. This suggests that

---

[147] In the final model for the late 80s/early 90s, both Group Practice and MDs per capita associations fall just shy of statistical significance.

[148] As would be expected, the Economic Growth and Per Capita Income variables were highly correlated in the 1988 to 1993 data set, and it was difficult to determine which variable was should be included in the final model. Please see Chapter 4, pages 13-14, for an explanation of the choice of Economic Growth.

the natural market for HMO health insurance does not include the entire U.S. population but only persons with certain attitudes and circumstances that are congruent with HMO enrollment. As a result, it becomes plausible that the HMO industry reached maturity in the 1990s despite never enrolling more than 30% of the U.S. population.

The results of this study, presented in Chapter 4, offer significant evidence that the relationship between HMOs and the physician profession changed substantially between the 1970s and the early 1990s. In the earlier period, more physicians in group practice and a higher concentration of physicians overall were associated with faster growth, but in the later period these factors showed a moderate association with declines in HMO enrollment. Non-physician factors associated with HMO growth also changed.

When these results are viewed within the diffusion of innovations framework, it appears that the HMO industry was approaching maturity in the late 1980s and early 1990s. If the adopter categorization system is applied to entire MSAs, these results suggest that the innovator and early adopter cities had passed their period of maximum growth by 1988, and rapid growth was more likely to be seen in late majority and laggard cities.

This interpretation implies that cities that earlier were hospitable to the HMO movement started to see their growth curves level off and that the previously less favorable cities began to catch up. This suggestion is reinforced by subsequent national HMO enrollment trends. U.S. HMO enrollment reached a peak of 80.5 million in 1999 and decreased to 78.0 million by 2001 (InterStudy 2002). This pattern of plateauing or slow decline is consistent with the HMO product reaching maturity.

## B. Policy Analysis

This section is divided into 3 sub-sections. The 1st sub-section addresses 3 broad policy implications of this study. Policy implication #1 is that the changing nature of the HMO industry may open up new policy levers. But policy implication #2 is that, based on the available evidence, it is unlikely that new policies can easily or directly increase commercial HMO enrollment. Policy implication #3 is that HMO enrollment tends to plateau.

The 2nd sub-section addresses the inter-related issues of health care costs, the appropriate level of government to regulate HMOs and a bill of rights for HMO patients. The 3rd sub-section provides some thoughts concerning the future of HMOs.

### B1 BROAD POLICY IMPLICATIONS

This research has 3 broad policy implications. First, plausible causal factors associated with HMO growth or decline have changed in the past, and they may change again. Therefore, continued research is needed so that policy makers can be advised of any new policy levers that might influence HMO enrollment in the decade of the 2000s.

However, the second implication is that policies within the normal range of government actions are unlikely to easily or directly increase commercial HMO enrollment.[149] One of the original motivations of this study was to find policy levers by which government could increase HMO enrollment, particularly commercial enrollment, without mandating it. However, the factors found to be influential are usually not directly controlled by government policy, or influencing those factors would entail numerous other consequences besides a possible change in HMO enrollment. Therefore, if the desire to encourage HMO enrollment were to return, it would be difficult to find clear or efficient levers to serve that purpose. Since this study applies to the MSA level, the results of this study more directly apply to state and local HMO policy than to federal policy.

For example, the 1990s analysis presents substantial evidence that economic growth/ per capita income is negatively related to HMO growth. However, it would be absurd for any level government to deliberately reduce economic growth and per capital income for the purpose of increasing HMO enrollment. If the purpose were to decrease HMO enrollment, this finding is still of no help because economic growth is already a paramount goal of government at all levels, and they are already seeking to promote it as well as they can.

The results of the 1990s analysis also hold out the possibility that physician variables may still have some influence on HMO enrollment, with the caveat that any current influence is actually opposite in direction from that which may have prevailed during the 1970s. However, any public policy that affected the supply of physicians or the prevalence of group practice would have numerous effects on the health care system besides any possible effect on HMO

[149] Naturally, there is always the possibility of government intervention for the purpose of discouraging or even eliminating HMOs. For example, state governments could add difficult or impossible requirements for the issuance of an HMO license. However, such policies are not currently being contemplated, and analysis of their potential effects is beyond the scope of this study.

enrollment. Therefore, any suggestion that physician workforce policy should be revamped in the hopes of generating a noticeable impact on HMO enrollment would neither be plausible nor defensible.

The same logic applies to the related finding of Dranove et al (1998) that hospital concentration is negatively associated with HMO market share. There is no possibility that basic policy concerning the concentration of the hospital industry will be changed solely, or even primarily, for the purpose of influencing HMO enrollment.

Review of previous federal health policy initiatives leads to a similar conclusion that substantially increasing HMO enrollment would be difficult. The White House health care reform plan of 1993 proposed very substantial changes in the health economy, and a major concept of this plan was to use HMOs to control costs and improve access to care. President Clinton, First Lady Hillary Clinton and their advisers clearly believed it was not possible to achieve such effects without sweeping change.[150] Further back, the HMO Act of 1973 was intended to encourage HMO growth, but the HMO movement was growing rapidly before the Act was passed. The Act may have hurt enrollment as much as it helped it.[151] Both these episodes illustrate the difficulty of increasing commercial enrollment through deliberate government policy.

The 3rd broad policy implication is that there is excellent reason to believe that the growth years of the HMO industry are over. This is of interest to policy analysts and policy makers because policies are often implemented, and often produce their effects, over a period of many years. Policy makers need to judge whether the health insurance industry of 10 years hence will be dominated by HMOs, or whether it is likely to have a structure similar to that which currently prevails.[152] The evaluation of many health care and health finance policies, including proposals for coverage of prescription drugs by Medicare, may be altered depending on beliefs concerning the future of U.S. health insurance.

The observed shift in factors affecting HMO growth suggests that enrollment tends to plateau on the MSA level. On the national level, enrollment has peaked, and it has gone down slightly in the last 4 years. Congruent with the national results, enrollment seems to be stable or slightly declining in most states. Therefore, a similar condition seems to prevail on several levels. The previous discussion of the diffusion of innovations and the product life cycle shows why this development is logical, based on published theory and empirical work for other industries. Further research on the HMO product life cycle might support, deepen and elaborate on this analysis.

---

[150] Congress and the public rejected the White House proposal because they believed it entailed too much risk and not enough benefit to justify such sweeping changes.

[151] Specifically, the Kaiser system, which accounted for most of national HMO enrollment in 1973, reduced its expansion program in response to the HMO Act! Brown, Lawrence D. Politics and Health Care Organization: HMOs as Federal Policy, 1983, p.330. Additionally, the analysis of HMO growth from 1973 to 1978 presented here did not show any effects that could readily be attributed to the Act. However, it may have contributed to HMO growth in the long run by increasing awareness of the HMO concept and signaling that legislatures would be unlikely to ban or repress HMOs.

[152] Clearly, there are numerous other possibilities for health insurance in the year 2013, including scenarios in which HMO enrollment is much smaller than it is now.

## B2 SPECIFIC POLICY ISSUES

Chapter 1 introduced several policy issues, including the relationship between HMO growth and health care cost control. If the question is whether HMOs can continue to serve as tools for cost control in the commercial insurance market, then the evidence appears positive. At this point, the strong preponderance of the evidence is that HMOs reduce health care costs, and they have had a major impact on costs because they have evolved and adapted to local market conditions throughout the country. Insofar as the basic issues in the health economy have not changed, it appears the HMO industry is capable of adapting to the conditions of the 2000s and continuing to offer cost control options to consumers and businesses.

However, if the question is whether further government policy to encourage HMO enrollment is likely to prevent further escalation of health care costs, then the answer is no. As discussed above, government policy does not have that much influence over HMO enrollment, especially not in the commercial market, and the ability of HMOs to control costs may be less today than it was 10 years ago. As was discussed in Chapter 1, recent policy initiatives at both the State and Federal levels have tended to reduce, rather than expand, commercial HMO cost control capabilities.

Another policy issue concerns whether Federal or State governments should take the lead in regulating HMOs. This study has not found strong grounds for either substantially different policy across the 50 states or for Federal imposition of a uniform policy nationwide. Possibly, level of government and other policy parameters should adjust dynamically to evolutionary changes in the industry.

As was discussed in Chapter 1, much of the policy focus has shifted from efforts to encourage HMO enrollment to assessing and changing the manner in which HMOs operate. One of the key policy issues of the late 1990s and early 2000s was the "Patients' Bill of Rights." Despite this broad title, patients' bills of rights usually only apply regulations and restrictions on HMO operations. One major component of many bill of rights proposals is to permit patients to appeal HMO denials of coverage to outside bodies, sometimes to a medical peer review organization (PRO).

California and several other states have enacted patients' bills of rights. In 2001, different versions of this legislation passed both the U.S. House of Representatives and the U.S. Senate. However, the differences between the House and Senate versions were not resolved that year, and this federal legislation did not advance in 2002 or so far in 2003.[153]

In fact, a federal patients' bill of rights may be less urgent in light of the patterns and trends of HMO enrollment presented in this study. If there were a strong expectations that HMOs would dominate U.S. health insurance in the coming years, than businesses and individuals might have little choice but to purchase insurance from HMOs. In that case, it could be appropriate for the federal government to closely regulate HMO operations and decisions. However, the reality, for now and for the foreseeable future, is that most businesses and many

[153] It is noteworthy that the high water mark of the federal patients' bill of rights was passage by the House of Representatives in August 2001, shortly before the September 11 terrorist attacks. Some might argue that this legislation does not appear to be as urgent for the federal government in the wake of those attacks and the issues they raised.

individuals have health insurance choices other than HMOs, most notably preferred provider organizations (PPOs).

In this circumstance, the natural regulation of a competitive market is likely to be the most effective check on HMO operations and practices. If HMOs abuse their power or don't respect their patients' medical needs, then it would be reasonable to expect a major shift away from HMO insurance. The availability of greater state regulation provides another check on undesirable HMO practices. In these circumstances, blanket federal regulation could reduce local autonomy and deter innovation without offering substantial additional protection to consumers. Therefore, the analysis of this study offers a possible reason for the deferral of federal patients' rights legislation.

B3 THE FUTURE OF HMOs

Thirty years of vigorous HMO growth have ended, and the tight restrictions on utilization of the 1990s have significantly eroded.[154] Some analysts now anticipate the demise of this economic form. Two who remain sympathetic with the HMO concept find, "... many health plans report that they simply have ceased to try to sell the traditional HMO product because of consumer leeriness and regulatory unwieldiness."[155] Another authority states we are in for a "very messy and very smelly" process of dismantling managed care.[156] Some financial analysts believe that the blossoming increase in health care costs will further cut HMO profit margins.[157] Additionally, the continuing decline in Medicare HMO enrollment and the aging of the population is not favorable to resumption of HMO growth (NY Times 2001, 2002).

On the other hand, there is some possibility that growth will resume in response to re-escalation of health care costs and a lower rate of overall economic growth.[158] There is also a possibility that much of HMO enrollment may shift back into staff/group HMOs such as Kaiser Permanente.[159]

However, the product life cycle is one of the most useful concepts for analyzing and understanding many industries, including the HMO industry (LA Brown 1981). The results of the research performed here are consistent with a life cycle approach, and the preponderance of the evidence indicates that HMO insurance has reached the maturity stage of its product life cycle. It is rare for products to "become younger" and return to an earlier stage of their life

---

154 New York Times "A Changing World Is Forcing Changes on Managed Care" July 2, 2001, American Health Line (AHL) "Aetna: Can the Ailing Insurer Recover from Recent Woes?" 2/26/01; AHL "Aetna Abandons 'All Products Policy' For Doctors" 12/20/00; AHL "UnitedHealth: Ends Pre-authorization, Gives MDs Final Say" 11/8/99.

155 Hurley and Ginsburg "Badly Bent Out of Shape: The Transformation of Traditional HMOs" May 2001, draft distributed at the 8th Princeton Conference On the Future of Managed Care.

156 "Like an unembalmed corpse decomposing, dismantling managed care is going to be very messy and very smelly, and take awhile." George Lundberg, quoted in AHL 3/26/01.

157 AHL "MCO Stocks: Wall Street Grows 'Bearish' About Industry" 7/3/01.

158 Hewitt Associates estimated that employers and workers were both paying about 7% more for health insurance in 2001 than in 2000, NYT 7/2/01, and official estimates suggested that health care costs have been re-escalating substantially (Levit et al 2002).

159 AHL 5/2/01 story on Kaiser Permanente and 3/21/01 story on Colorado HMOs. Kaiser remains unique among HMOs in its ownership of a large chain of hospitals. For background on Kaiser's previous difficulties, see WSJ "In Age of the HMO, Pioneer of the Species Has Hit a Rough Patch", 12/1/94, p. A1.

cycle, although this has been accomplished in a few cases through strong promotion or repositioning (Kotler and Armstrong 2001).

Marketing textbooks indicate that the maturity stage normally lasts longer than the introduction or growth stages. It is characterized by intense price competition. Firms seek to defend or increase market share, which implies that competition is focused on existing customers rather than on drawing new customers into the market. Firms typically try to introduce new and improved versions of the product in the interests of extending the maturity stage and forestalling decline (Bearden et al 2001, Kotler and Armstrong 2001). This suggests that further HMO evolution and price competition may enable the industry to maintain enrollment, but substantial overall growth is unlikely. Perhaps there is potential for growth in certain areas where HMOs have still not attained 20% market share, but there also may be further enrollment decline in areas with high market share (LA Times 2002). A return to 12-13% annual growth in U.S. HMO enrollment is very unlikely.

Although the evidence appears to be consistent and reasonable, these analyses and projections must be tempered with caution. This statistical analysis is for a period ending in 1993, so it cannot reflect new trends or further shifts in the complex relationships that influence HMO enrollment. The product life cycle is clearly an applicable concept and tool for the HMO industry, but predictions based on life cycle assumptions have been just as fallible as all other predictions. Bearden et al (2001) state, "the product life cycle has limited relevance in forecasting future performance." Finally, HMO enrollment, like all health care organizational and financial arrangements, is likely to be strongly influenced by technological changes in health care, including genetic diagnostic and therapeutic methods. At this point, it is not clear whether these impending changes will lead to higher or lower HMO enrollment.

HMOs were thought to embody a new paradigm in health care finance; they would lead to the creation of a more efficient and more effective health care sector in the U.S. (Enthoven and Kronick 1989). They have certainly had a dramatic effect on the financing and delivery of health care (Zwanziger et al 2000). But HMO growth has stopped, and many major elements of the health care sector, particularly the central role of physicians, have survived the HMO challenge. However, the growth of HMOs may be valuable to study as a precedent and reference when analyzing other health care trends and movements.

## C. Technical Conclusions

In order for a study to be published, its authors must demonstrate how it advances and improves upon the knowledge of the field. Generally, new findings suggest additional research questions. Many studies also pioneer or refine methods of operationalizing concepts or collecting, processing or analyzing data, and these new methods must be documented and their soundness and effectiveness demonstrated. Sometimes innovative methods generate greater interest among researchers than the initial findings generated using those methods.

This study may be of interest for its research findings and its research approach and methods. The findings themselves are summarized in the first section of this chapter, but they are compared with prior expectations and placed in the context of prior research here. This section also addresses the unusual methods employed and suggests further research to both advance knowledge of the field and to apply and extend the methods utilized here.

### C1 COMPARISON WITH EXPECTATIONS

Following completion of descriptive statistical analysis for each of the 2 periods under study, expectations for the multiple regression results for each of the periods were developed and announced.[160] For the mid 1970s, hypotheses concerning 4 of the possible explanatory variables were designated as primary, and expected associations were stated for 11 additional variables. For the late 80s/ early 90s period, the author designated 4 primary hypotheses, and expected associations were designated for 5 additional variables.[161]

Table 5-1 compares actual with expected results for the most critical variables.[162] If the variable was the subject of one of the primary hypotheses for that period, then the expected association is indicated in capitals; otherwise the expected association is shown in lower case. This table lists the analysis period, the specific variable and both the expectation and the result for that variable. For a few variables, a comment is provided. For each period, the table only shows those variables that were the subject of primary hypotheses or that were included in the final analytic model.

As Table 5-1 shows, 3 of the associations predicted for the mid 1970s period were supported by the regression analysis. All 3 involved provider-related variables, namely MDs per capita, RNs per capita and % of Physicians in Group Practice. However, only the MD association had been designated a primary hypothesis for this period. The other 3 primary hypothesized associations, for Hospital Beds per capita, Blue Cross/Blue Shield Market Share and Income per capita, were not supported at all by the regression analysis.

---

160 This process is more fully explained in Chapter 3, sub-section B3.

161 For the original statements of expectations, please see "Final Memo to Committee Before 1970s Regression Runs", unpublished, dated April 4, 1996, and "Final Memo to Committee Ever: Preparation for 1990s Regression Runs", unpublished, dated September 27, 1999. These memos are both included in Appendix F to this Thesis.

162 Please see Table F1, Comprehensive Comparison of Results With Expectations, for a longer version of Table 5-1 showing all the expectations stated prior to the completion of each of the regression analyses.

## TABLE 5-1
## COMPARISON OF RESULTS WITH EXPECTATIONS

| Period | Variable (Abbrev) | Expected Association | Actual Association | Comment |
|---|---|---|---|---|
| | | | | |
| 1973-78 | MDs | POSITIVE | POSITIVE | |
| | Hospital Beds | POSITIVE | NONE | |
| | BC/BS | POSITIVE | NONE | |
| | Income | NEGATIVE | NONE | |
| | Group Practice | Positive | POSITIVE | Strongest Result |
| | RNs | Positive | POSITIVE | |
| | Latitude | Positive | NEGATIVE | |
| | | | | |
| 1988-93 | Econ Growth | NEGATIVE | NEGATIVE | |
| | Establishment Size | POSITIVE | NONE | |
| | Pop Density | POSITIVE | NONE | |
| | Net Migration/ Pop Growth | NEGATIVE | NONE | |
| | MDs | None | NEGATIVE | Reversed Direction from Previous Period |
| | Group Practice | None | NEGATIVE | Reversed Direction from Previous Period |
| | E North Central | None | NEGATIVE | |

---

Additionally, there was some expectation that Latitude would show a positive association in these regressions, namely that HMO market share would grow faster in more northerly cities. But the final model for the 1970s shows a negative association with latitude. The actual findings and their interpretation and import are discussed at great length in Chapter 4, Sub-sections B2 to B5.

For the early 90s period, only one of the predicted associations, the one for economic growth, was supported by the regression analysis. The hypothesis that economic growth over the period from 1978 to 1993 would have a negative association with HMO growth from 1988 to 1993 was one of the primary hypotheses for this period. The other 3 primary hypothesized associations, for Employees per Establishment (aka Establishment Size), Population Density and Net Migration/Population Growth[163], were not supported at all by the regression analysis. Conversely, 3 of the variables that were not predicted to show any association, namely MDs per capita, % of Physicians in Group Practice and location in the East North Central (aka

[163] Net Migration and Population Growth have a positive correlation of .75 in this data set.

eastern Midwest) region, all showed negative associations with HMO growth. The findings for the late 80s/ early 90s are discussed in Chapter 4, Sub-sections B6 and B7.

The comparison of results with expectations clearly shows that these 2 analyses yielded a number of surprises. Both the academic and journalistic literatures had posited a confusing variety of hypotheses about factors associated with HMO growth, and no one explanation was strongly supported by the available evidence. However, the 1970s analysis shows that economic conditions of the health care professions, primarily medicine but also nursing, had a strong association with HMO growth at the MSA level. The 1990s analysis indicates that the effect of the physician related variables reversed direction. The counter-intuitive expectation that Economic Growth had a negative effect on HMO growth from 1988 to 1993 was borne out.

C2 COMPARISON WITH PRIOR STUDIES

A natural question that arises in reviewing the 1970s findings and analysis is "How do these results compare with those of the similar studies discussed in Chapter 2, Section D (Goldberg and Greenberg 1981, Morrissey and Ashby 1982, Welch 1984)?" Similarly, the results for the 1990s can be compared with those of Dranove et al, which are also presented in Chapter 2.

The results for the 1970s initially seem very different from those of the prior studies. But closer examination shows that several observed associations, as measured by variable co-efficients, are roughly comparable. Furthermore, most of the observed differences in co-efficients can be reasonably explained.

None of the 3 previous studies tested RNs per capita or Latitude, so these results are not directly comparable.[164] The variables for which there are comparable results are Group Practice and MDs per capita. The comparison is presented in Table 5-2. The top of the table compares results for Group Practice, and the bottom makes the same comparison for Physicians per capita. In the table, each study is identified by its authors' names, with Markovich listed last. For each study, the table presents the analysis period, the size of each effect, the standard error of the effect and the resultant t statistic.

Two of these 3 studies examined the possibility that Group Practice influenced HMO growth. Interestingly, both their regression results present evidence of an effect of the same direction and order of magnitude as this study finds. This Ph.D. thesis finds that HMO enrollment increased by .17 percentage points (i.e. .17 of 1% of the MSA population) for every increase of one percentage point of physicians in group practice at the state level. Goldberg and Greenberg found a comparable effect of .11 percentage points, and Morrissey and Ashby

[164] As discussed in Chapter 4, Sub-section B5, there were some indications that the negative association with Latitude was really driven by a negative effect of Firm Size or by effects of other economic variables confounded with Latitude. Morrissey and Ashby tested Establishment Size and found very weak evidence in favor of a positive association. However, since they used a different measure of Establishment Size than is used in this study, it is difficult to analyze the difference in these results.

## TABLE 5-2
## COMPARISON OF SELECTED 1970s RESULTS WITH THOSE OF PRIOR STUDIES

| Study Authors | Period Analyzed | Estimated Effect | Standard Error | t-value |
|---|---|---|---|---|
| | | (% Points) | (% Points) | |
| *Group Practice* | | | | |
| Morrissey and Ashby | 1975-78 | .097 | .083 | 1.17 |
| Goldberg and Greenberg | 1966-76 | .110 | .061 | 1.80 |
| Markovich | 1973-78 | .172 | .023 | 7.52 |
| | | | | |
| *MDs per capita* | | | | |
| Morrissey and Ashby | 1975-78 | 1.16 | 1.86 | .62 |
| Markovich | 1973-78 | 2.11 | .592 | 3.56 |

NOTE: Unit for Group Practice effect is percentage point increase in HMO enrollment per percentage point increase in proportion of MDs practicing in groups. Unit for MDs per capita effect is percentage point increase in HMO enrollment per unit increase in number of physicians per 1,000 population.

---

found an increase of .10 percentage points. But since the association generated a lower t-statistic in both prior studies, the finding was not emphasized in one study and explicitly discounted in the other.[165]

Only one of these predecessor studies examined the proportion of MDs in the population as a factor contributing to HMO growth. The most applicable regression equation found an effect in the same direction and order of magnitude. Specifically, this thesis finds an increase in HMO enrollment of 2.11 percentage points for every additional physician per 1,000 population, while Morrissey and Ashby find a comparable effect of 1.16 percentage points. But again a much lower t-statistic resulted in the finding being disregarded.[166]

For both group practice and MDs per capita, the material difference in the size of the effects seems to stem from differences in the study populations. Goldberg and Greenberg used the entire state as its unit of analysis, and small rural states had as much influence on their results as did California and New York. Morrissey and Ashby used MSAs as this study does, but they included all MSAs while here we only consider the 75 largest.

---

[165] Goldberg and Greenberg's finding showed a t-statistic of 1.8, significant at the .10 level, but Morrissey and Ashby only got a t-statistic of 1.2 (I got a t of 7.5). A t of 1.2 is considered to be a non-finding, and the authors explicitly state that in their conclusions (p. 147). These prior studies got much lower t-statistics because the standard errors of the coefficients for this variable were much higher. It appears that these standard errors were higher because of collinearity among the explanatory variables in the models they specified and presented.

[166] Specifically, their t-statistic is .63 for MDs per capita, while my t is 3.56. As with Group Practice, the difference in the t's is largely attributable to a much higher standard error in the prior study, and the higher standard error seems to stem from collinearity of their explanatory variables.

In many smaller MSAs in the 1970s, the active physician community may have had only 150 or fewer members. By contrast, almost all of the 75 largest MSAs had more than 500 MDs, and most had more than 1,500. The economic relationships and social dynamics within a 150 MD community may well have been very different from the relationships within a 1,000 MD community, and these differences are likely to have influenced the process of HMO acceptance and affiliation within those differing physician communities.[167]

Alternatively, there is a technical reason why a study of all MSAs would find a smaller Group Practice effect. Group Practice data are only available on the State level. In most cases, a state average will be more accurate for larger MSAs, each of which constitutes a greater component of that average, than it will for smaller MSAs. It is possible that more accurate measurement of Physician Group Practice at the MSA level would lead to more similar estimates of this effect on HMO enrollment in both large and small cities.

Taken collectively, the prior studies found some evidence for a negative effect of per capita Income, a positive effect of Hospital Costs and a positive effect of Population Mobility.[168] As shown in Chapter 4, this study did not find meaningful evidence for any of these effects. As with the physician related variables, it is possible that these factors had an effect in smaller MSAs that did not exist in this study's population of MSAs.

It is more difficult to compare this study's results for the early 1990s with those of Dranove et al. Although the time periods of the 2 studies are roughly comparable, the differences in the definition and measurement of the outcome variable are considerable. Dranove et al use managed care penetration as their outcome variable, and PPO enrollment was a larger component than HMO enrollment by the 1993-95 period. Furthermore, Dranove et al estimated managed care penetration using a physician survey and a market research survey. Such survey results reflect a different perspective on the growth of HMOs and managed care than is reflected by the direct enrollment data used by this study. Additionally, most of the specific explanatory variables tested by Dranove et al differ in substance from the explanatory variables utilized in this study.

However, there is some similarity in flavor between the 2 sets of results. Most notably, Dranove et al found that health care supply variables had a considerable effect on managed care growth in the 1980s and early 1990s, and this is consistent with the findings reported here. They found some evidence of a non-linear relationship between firm size and managed care during their study period, while this study finds some evidence that HMOs grew more in cities with smaller employers during the 1973-78 period.

One area of possible inconsistency between the studies is the size of physician practices. They found that large having more physicians in solo practice may have had a negative effect on managed care penetration, while this study finds that, by 1988-93, there was a negative

---

[167] However, this likely difference detracts from the external validity of this study. The results are valid for the 75 largest MSAs and the majority of the US population that resided therein, but apparently the causes of HMO growth were (and possibly still are) substantially different in smaller MSAs and in rural areas.

[168] Specifically, for all 3 of these variables, 2 out of the 3 prior studies found evidence attaining or approaching statistical significance for the effects listed. Please see Appendix G for a Summary Table.

relationship between physicians in group practice and HMO enrollment growth. However, substantial differences in both the outcome and explanatory variables make meaningful comparison of these specific results difficult.[169]

## C3 CONTEXT OF THE HMO ECONOMIC LITERATURE

This report makes extensive reference to 2 broad sets of scholarly literature. The first of these is the diffusion of innovations literature, which is used to establish a framework of how industries in general grow. The results of this study are placed within the context of the diffusion of innovations literature in sub-section A2 of this chapter. The second set of literature is the HMO economic and health services literature, and Chapter 2 is devoted to that literature. This sub-section discusses how the results of this study fit in with and contribute to the HMO specific literature.

Recent evidence shows that persons who are willing to give up provider choice for cost savings are more likely to enroll in HMOs (Kemper et al 1999/2000). But only a certain percentage of the population is willing to make that tradeoff, so this finding suggested that HMO enrollment was likely to plateau. In fact, HMO enrollment on the national level has plateaued in the last few years (InterStudy 2002). This is consistent with the findings of this study. Analysis of HMO enrollments from 1988 to 1993 shows that factors associated with HMO growth on the MSA level were different than the factors associated with growth during 1973 to 1978. This finding is consistent with the hypotheses that HMOs were approaching the maturity stage of the product life cycle and that the period of rapid growth would end during the 1990s. Thus this study fits in well with other evidence concerning the overall trend of HMO enrollment.

Much of the published HMO literature is on the consequences, rather than the causes, of HMO growth. However, by investigating the causes of HMO growth, this study complements the published literature. Prominent among the more recent findings, Escarce et al (2000) find that HMO growth tends to reduce the number of physicians in an MSA[170]. However, during an overlapping period of time, this study suggests that lower numbers of physicians and a smaller proportion of group practice physicians tend to increase HMO growth at the MSA level.

In conjunction, the 2 studies suggest an acceleration effect with respect to the concentration of physicians. At least during the 1988-93 period, lower concentrations of physicians are associated with HMO enrollment growth, and HMO growth reduced total numbers of physicians in metropolitan areas. Thus the cities with a relative sparsity of physicians would have experienced a further decline in number of MDs (and probably Osteopaths as well) relative to metropolitan areas with a relative abundance of physicians. If this acceleration effect were dominant, it would have widened the gap between physician-sparse and physician-abundant cities during this period. This issue is discussed further in the final sub-section, Suggestions for Further Research.

---

[169] Dranove et al used the MSA percentage of *primary care* physicians in solo practice in 1985 as their explanatory variable, while, for the 1988-93 period, this study uses state level percentage of *all* physicians in group practice in 1988 as an explanatory variable.

[170] They found that HMO market share did not affect the number of generalists, but it did reduce the number of medical/surgical specialists and the overall number of physicians.

Similarly, the findings of this study can be combined with the well-established finding that HMO growth leads to a reduction in hospital costs to suggest additional hypotheses. Specifically, during 1988-93 cities with rapid economic growth experienced less HMO growth while cities with less economic growth saw faster HMO growth. However, the lack of statistical association between hospital costs and HMO growth during this period suggests that hospital costs did not have a substantive effect on growth. Therefore, using the findings from other studies (Miller and Luft 2001, Gaskin and Hadley 1997, Miller and Luft 1994), it may be possible to build a causal chain: lower economic growth led to faster HMO growth, which led to a reduction in hospital costs.

## C4 METHODOLOGICAL IMPLICATIONS

As detailed in Chapter 3, this study has applied some unusual methods. These methods are consistent with the framework provided by the diffusion of innovation literature, and they have generated a substantial set of findings and implications. Researchers may be interested in what this process can teach us about the findings of other studies and how future studies can adopt or adjust some of these methods.

Rather than setting out to confirm or deny one particular concept or hypothesis, this study set out to analyze a particular phenomenon, namely the growth of HMOs on the MSA level. Because the subject matter is broad, and because of the limited number of observations in the data set, a flexible approach was taken in developing a model of HMO growth. Specifically, for both time periods that were analyzed, a large number of variables and combinations of variables were tested before selecting the final model. This approach entails the risk of over-fitting, of developing a model that conforms to the peculiarities or random disturbances of the particular data set being used at the expense of developing a useful and applicable structural model.

To reduce the risk of over-fitting, very specific expectations were stated prior to the execution of the 2 sets of analysis. The accuracy of those expectations was just examined in Sub-section B1. The prior statements of expectations did not constrain the development of the final models, but they restrain the ability to claim that those models were expected all along. By doing so, the statements made it clearer what knowledge was gained and what value this knowledge has. Ideally, this new knowledge should be used to state expectations for a different study using substantially different data. If expectations derived from this study were confirmed by an independent examination of a related subject, then there would be strong assurance that the results presented here are accurate.

Another major issue was endogeneity, the threat that the outcome variable may have influenced one or more explanatory variables instead of, or in addition to, the explanatory variables influencing the outcome. One approach to this issue is to use an instrumental variable; an elaboration on the instrumental variable approach is to use 2 Stage Least Squares (2SLS).[171] This approach was not applied here. Instead, prior values for the explanatory variables, which in the normal course of events could not have been influenced by the

[171] This approach is discussed in Chapter 3. For a more technical discussion, please see Kennedy (1992).

subsequent growth of HMO market share, were used.[172] In Chapter 3, this is referred to as the Growth Prediction method. Some of these prior values showed substantial explanatory power in the regression analysis, indicating that they had a truly structural, or causal, effect on HMO growth during the periods under study. Because of several difficulties with the instrumental variable/2SLS approach, researchers may wish to consider the Growth Prediction method for other applications.

Another feature of this study is the application of similar methods to 2 distinct periods of time. Reference to the product life cycle concept suggested that results for the 2 periods would be somewhat different. In fact, results were very different, and the statistical associations of the physician related variables reversed direction between the 1st period and the 2nd period. These results can be used to illustrate the usefulness of the product life cycle concept for empirical research.

## C5 SUGGESTIONS FOR FURTHER RESEARCH

This sub-section makes suggestions for additional research in 10 different areas. The first 3 concern testing the product maturity hypothesis and the inter-relationship between the physician workforce and HMOs, and these will be of immediate interest. Other promising areas for research include the relationship between the nurse workforce and HMOs, resolving the economic growth/per capita income issue, extending this analysis to additional years and geographic areas, conducting separate analyses for commercial, Medicare and Medicaid enrollment and investigating the influence of HMO model type. The last 2 suggested areas for further research are Point of Service plans, which are a variety of HMO, and Preferred Provider Organizations, which are a form of managed care but are distinct from HMOs.

### *Testing the Product Maturity Hypothesis*

One of the most important challenges for further research is to confirm or refute the suggestion that the HMO industry was approaching maturity during 1988 to 1993 and that the upcoming leveling off of national HMO enrollment could be inferred from MSA-level growth trends during 1988 to 1993.

Clearly, the evidence of this study, the product life cycle concept and subsequent trends in national enrollment show a consistent pattern. This evidence suggests the potential market for HMO insurance was always large, but probably less than half the population in most cities and states. By 1988, the HMO health insurance product was reaching the limit of its potential market in a number of MSAs, including Minneapolis-St Paul, Cleveland and Denver. During 1988 to 1993, enrollment hardly grew or actually declined in these cities, and the 1987/88 peaks were never substantially exceeded. On the national level HMO health insurance reached maturity in the late 1990s, and overall enrollment is likely to be stable or slightly declining for many years. However, the available evidence is not conclusive, and any claim that the results of this study anticipate broader trends in HMO enrollment must be carefully scrutinized.

In particular, national HMO enrollment did not peak until 1999. Had this statistical analysis been available in 1993, a fair conclusion would have been that the industry was rapidly

[172] If the outcome variable were HMO market share per se, then it would have been much more difficult to provide assurance that the explanatory variables were not endogenous.

approaching the maturity stage of the product life cycle and that enrollment would probably peak in the next 3 years. Additionally, the argument concerning the potential HMO market would be simpler and more testable if all cities, and the country as a whole, have the same "natural" level of HMO market share, but there is substantial evidence against such a hypothesis.

If all geographic areas had the same natural level, one would expect that there would be a high negative correlation between 1988 market share and market share growth between 1988 and 1993. This would be because enrollment would stop growing in cities with high market share and growth would accelerate in cities with low market share. In fact, for the dataset analyzed here, the correlation between 1988 market share and 1988-93 growth is -.08. For this small data set, this level of correlation suggests there was essentially no relationship between initial market share and subsequent growth.[173] A simplistic model under which all MSAs inexorably honed in on one particular level of HMO market share is not supported by the available data.

However, it may be that different cities have different natural levels of market share, depending on market conditions, health care institutional arrangements and the local labor market. The data may be consistent with a view that, by 1988, market share growth had slowed down or stopped entirely in MSAs that were close to their natural level. Conversely, other cities, including some with high market shares, may have been far short of their natural HMO market share in 1988. These may have been the MSAs where market share grew the fastest from 1988 to 1993.

One goal for further research is to test the usefulness of this set of hypotheses and the accuracy of the implications that flow from these hypotheses. The central hypothesis can be referred to as the product maturity hypothesis, the concept that HMO enrollment growth slows down and eventually stops as the HMO product reaches maturity in a particular market or geographic area. One way of testing the product maturity hypothesis and its implications is to build a model of MSA level market share growth around this concept and to assess how well the data corresponds to such a model.

A model of HMO product maturation in each MSA would necessarily be more complex and sophisticated than the ordinary least squares multiple regression models employed in this report. However, it may be possible to operationalize and test such a model by focusing on 2 major elements. The first major element of the model would generate estimates of the natural HMO market share for each MSA. The second major element would simulate HMO market share over time as it approached and stabilized around the natural level. The second element would incorporate the S-shaped curve or logistic function in generating the simulated time path for each MSA or other geographic unit included in the study.

If a more sophisticated model of this type could yield a substantial improvement in goodness of fit over one or more simpler models, than this would constitute serious evidence in favor of the product maturity and logistic growth concepts. However, specifying, operationalizing and testing such a model constitutes a formidable research challenge.

---

173 However, the comparable correlation was +.38 for the 1973-78 period, and the decline to -.08 for the later period constitutes further evidence that the dynamics of HMO growth underwent change.

*Factors Leading To Initial HMO Establishment*

As discussed in Chapter 4, the 1973-78 results offer substantive evidence concerning enrollment growth in many cities that had operational HMOs at the beginning of the period. The available results offer little useful evidence to explain why 1 or more HMOs began operations in 19 of the 47 cities with no HMOs in 1973. Any comprehensive theory of HMO enrollment must address that initial diffusion of HMO insurance into any given market.[174] That diffusion process was almost complete for the 75 largest cities by 1988, but it continued to be an issue in small cities and rural areas well into the 1990s. To some extent, it remains an issue today for many such areas where there are still no operational HMOs.

Perhaps the best way to address initial HMO establishment would be to perform a series of in-depth case studies of this process in numerous markets over a period of 25 years or more. The series could include studies of areas where the HMO concept failed to diffuse within a specified time period. It would be desirable to include cities of all sizes and rural areas. Such an approach would be likely to generate well thought out hypotheses concerning the causes of successful HMO establishment. It would then be appropriate to design statistical studies or other follow-up research to develop a definitive enumeration of the causes of initial HMO operation.

However, it is possible that immediate further statistical research could yield noteworthy results. In particular, it may be useful to use the date of successful HMO establishment as the outcome variable and to investigate the relationship between that date and a wide range of variables. It would be desirable to test the geographic dispersion hypothesis – i.e. to see if HMOs were more likely to begin operations in geographic areas proximal to areas that already had operating HMOs. Finally, if more specific geographic data could be developed, it would be worthwhile to investigate the relationship between the profitability of other health insurers and initial HMO establishment.

*Inter-relationship Between the Physician Workforce and HMOs*

As mentioned earlier in this chapter, Escarce et al (2000) find that HMO growth tends to reduce the number of physicians in an MSA. When this finding is combined with the finding that, during 1988-93, HMOs grew faster in MSAs that already had lower concentrations of physicians, it suggests that HMOs may have widened the gap between physician-sparse and physician-abundant cities during this period. Further research could confirm or deny that this gap widened during the late 1980s and early 1990s and that MSAs with rapid HMO growth were the ones experiencing a relative decline in physician concentration.

This proposed research project would require the construction of an index of the variance in physician concentration across MSAs during the period of interest. Escarce et al cover the years 1987 to 1997. A new study might analyze data for the years 1987, 1992, 1997 and 2002. If such examination of the variances in physician concentration finds that these variances are increasing over time, the study should seek to ascertain whether the increase was associated with HMO market share.

---

[174] As discussed in Chapter 2, there have been a few studies of the formation of new HMOs and of the demise of individual HMOs, but no studies of the establishment of initial HMOs by geographic area.

If physician concentrations across MSAs are diverging, it may be that the cities with high and increasing physician concentrations are the ones with the lowest levels of HMO market share; conversely, the cities with low and stagnant physician concentrations may be the ones with the highest levels of HMO market share. One possible way of testing this hypothesis would be to use HMO market share to estimate both initial physician concentration and change in physician concentration for all 5-year periods. Confirmation that high or increasing HMO enrollment tends to widen disparities in physician concentration would be of interest to a broad range of researchers, policy analysts and health care decision makers.

*Attitudes of Group Practice Physicians Toward HMOs*

The findings of this study concerning the proportion of group practice physicians and HMO enrollment growth are remarkable. As discussed in Chapter 4, it may be possible to explain these findings either specifically in terms of changes in the attitudes of physicians in group practice or in terms of the overall evolution of the HMO industry. These 2 sets of explanations are distinct from each other, but not necessarily in conflict. Changes in the attitudes of group practice physicians may have been, in whole or in part, a consequence of HMO evolution. (The overall evolution of the industry is addressed in the first suggestion for further research above.)

The hypothesis that the attitudes of group physicians toward HMOs became less favorable can be supported with several points. First of all, part of the evolution of the HMO industry was the emergence of independent practice association (IPA) HMOs as the dominant form. In the early 1970s, staff HMOs accounted for the overwhelming majority of HMO enrollment, but by 1993 over two-thirds of HMO enrollees belonged to IPAs or mixed model HMOs that operated predominantly on an IPA basis (InterStudy 1994). Therefore, it is very plausible that group practice physicians of the 1990s saw HMOs as a less congenial form of insurance than they had in the 1970s. Additionally, the nature of physicians in group practice is likely to have changed as economic and social forces led many physicians to abandon solo practice and join groups.[175]

Unfortunately, data concerning the attitudes of group practice physicians in the 1970s may not be available. However, during the 1990s, researchers conducted a number of surveys concerning physician attitudes toward HMOs, and it may be possible to synthesize or extract detailed information concerning the attitudes of group practice physicians from extant data. Of more practical interest, it is possible to investigate this issue now. A survey of group practice physicians could yield valuable information concerning HMO-physician relationships today and possible effects on future changes in HMO enrollment. The attitudes of today's group physicians may be particularly salient because of the continuing shift of physicians into small groups.

One key issue is whether group practice physicians are more satisfied with the degree of physician autonomy in treating HMO patients. Since many HMOs have abandoned some of their more restrictive utilization review policies, it is possible that group physicians now have

[175] For a while it appeared that the physician profession was moving toward organization in very large groups. Many of these groups have collapsed, and, as of 2002, it appears that this trend has completely halted. However, physicians continue to abandon solo practice and organize themselves into small groups.

more favorable attitudes in this area. A second key issue concerns the effect of HMO reimbursement rates on group practice physicians' incomes. HMOs continue to reimburse physicians at lower rates than other commercial health insurance plans do (Polsky and Nicholson 2001). If group physicians believe that they have a viable option for improving their incomes by declining to contract with HMOs, then this could contribute to a decline in HMO enrollment.

*Effect of Nurses on HMO Growth in the 1970s*

Researchers may be interested in explaining the unprecedented suggestion here that nurses influenced the growth of HMOs in the 1970s. With recent concern about a Registered Nurse (RN) shortage, a better understanding of how the nurse labor market influences the health economy would be interesting. One possible explanation, discussed in Chapter 4, is that a surplus of nurses influenced negotiations between hospitals and HMOs. Put bluntly, in certain markets hospitals extracted surplus value from nurses, and HMOs extracted some of this surplus from hospitals.

To test this hypothesis, we would ideally want extensive data concerning nurse wages and HMO reimbursement of hospitals, but such data are unlikely to be available for the 1973-78 period. However, data may be available on hospital profits or surplus during this period. If such data are meaningful, it would be possible to regress hospital profits on the MSA level as a function of the supply of RNs, HMO market share and other variables. If it were found that a greater supply of nurses had a positive effect on profits, but that increased HMO enrollment had a negative effect on profits, this would lend support to this elaborate and intriguing hypothesis.

*Resolving the Economic Growth/Per Capita Income Issue*

Another unresolved question concerns the choice between including Economic Growth and per capita Income in the final 1990s model. It is clear that one of these 2 variables, which have a correlation of .67 in the 1988-93 data set, had a negative effect on HMO enrollment. In Chapter 4 it is explained that Economic Growth was included because such an effect was more consistent with the boom and bust cycle that influenced enrollment during this period. But t statistics were generally slightly higher for per capita Income.

The simplest way of resolving the uncertainty concerning these 2 economic variables is to increase the number of observations. Extending the data set to include smaller MSAs or disaggregating to the County level, or both, could do this.[176] If increasing the number of observations by itself does not resolve the issue, it would make it possible to carve out 2 sub-data sets for comparative analysis. One of these would consist of MSAs, or Counties, that have consistently had high levels of per capita income, but which experienced only modest economic growth after 1970. The other subset would consist of MSAs which experienced rapid economic growth during the 1970-1993 period, but which were still not in the top

[176] Either method of expanding the data set could present problems. If smaller MSAs are included, there would be an implicit assumption that the causes of HMO growth were the same in those cities as in the larger ones. Accurately allocating HMO enrollment between Counties within each MSA could be very difficult; a less ambitious program would be to disaggregate the data for the 18 Consolidated Metropolitan Statistical Areas (CMSAs) into the component Primary Metropolitan Statistical Areas (PMSAs). The good side is that a well conceived and carefully executed extension of the 1990s data set could offer additional insights beyond resolving the Economic Growth vs. per capita Income question.

quadrant of per capita Income by 1993. Analyzing these 2 contrasting sets of urban units would be likely to resolve whether Economic Growth or per capita Income shows the stronger negative association with HMO growth.

Naturally, if further research finds that one variable or the other continues to show a statistically significant negative association, then it would be desirable to determine if that relationship continued during subsequent years.

*Extending the Analysis of HMO Enrollment*

This project has analyzed HMO enrollment growth for the periods 1973-1978 and 1988-1993. This type of analysis could be performed for other time periods since 1978, including periods between 1993 and 2001. In particular, the period from 1993-1998 saw accelerated growth, while national HMO enrollment has plateaued from 1998-2001. In concept, it would be simple to replicate this analysis for these periods, and more recent results would be of interest to both policy makers and researchers.

Analogously, it would be desirable to extend this analysis to more geographic areas. As discussed above, there are some indications that factors influencing HMO enrollment differ in large and small MSAs, and rural areas may well differ in this respect from MSAs. Therefore, it may be wise to conduct separate, parallel analyses for small MSAs and rural areas. However, it would certainly be noteworthy if any effects were found to work in the same direction and approximate magnitude in all 3 types of areas.

*Separate Analyses for Commercial, Medicare and Medicaid Enrollment*

One of the most serious limitations of this study is the inability to analytically separate Commercial, Medicaid and Medicare HMO enrollment for the 1988-1993 period and for subsequent periods.[177] Some distinct factors influence enrollment in each of these 3 markets, with Medicaid and Medicare enrollment heavily influenced, but not perfectly controlled, by administrative policies for these 2 government programs.[178] The analysis of the Commercial market could use methods quite similar to those employed here, and it would be very worthwhile to determine if the findings of this study are accurate for the Commercial market by itself.

An analysis of Medicaid HMO enrollment at the MSA level would need to include dummy variables reflecting the state where each city is located.[179] It is not clear what factors influence State policies toward Medicaid HMOs. Apparently, rapid increases in program costs stimulate officials to steer more beneficiaries into HMOs in the interest of controlling costs. Possibly State Medicaid officials consider the accessibility to Fee For Service care, as reflected in the numbers of physicians and other providers who accept Medicaid patients.

---

[177] Medicaid and Medicare accounted for a very small percentage of HMO enrollment before 1988.

[178] Analysis of combined enrollment offers some advantages, and these are discussed in Footnote 3 to Chapter 3. However, it would be a big advantage to have separate analyses for each of the 3 markets *in addition to* analysis of combined enrollment.

[179] Clearly proper coding for MSAs split between 2 or more states would be a challenge.

For Medicare, it appears that the competitiveness of HMOs is greatly affected by the average Medicare fee for service (FFS) payments in their area. Another unique aspect of the Medicare HMO industry is the need to offer benefits not otherwise offered by Medicare, most notably prescription drug coverage, in order to attract enrollees. An updated analysis of Medicare HMO enrollment would ideally choose analysis periods so as to consider the effect of major changes in Federal Medicare policy, especially the host of changes initiated by the Balanced Budget Act of 1997.

*Influence of HMO Model Type*

Another set of HMO categories is referred to as Model Type. We tend to think of 2 basic HMO types, Group and Independent Practice Association (IPA), but accurate classification is a serious challenge.[180] A considerable volume of HMO research in the 1970s and 1980s examined HMOs by type, and some studies found that Group or Staff HMOs offered superior preventive care and continuity of care.[181] However, the IPA model, whether in pure or mixed form, had a substantial advantage in the market place because it offered enrollees a greater choice of physicians and other providers. The influence of HMO type on HMO enrollment at the MSA level remains an open question, but one that is amenable to statistical analysis.

*Point of Service Plans*

One of the most important HMO trends of the 1990s was the rapid growth of Point of Service plans (POS, also referred to Open Ended plans). Enrollment in this type of HMO increased from 400,000 in 1988 to 7.8 million in 1997 and approximately 18 million in 2000.[182] It appears that these plans have grown because consumers want the option to go outside the network, but most don't actually do it. The low outside utilization keeps POS premiums competitive with those of pure HMOs.[183]

POS should definitely be considered part of the HMO family, and their enrollment was included in the outcome variable for this study. But it would be interesting to examine trends and patterns in POS compared to other Commercial HMOs. In particular, it would be desirable to see if POS plans are more attractive in high-income areas and to employers with high-income work forces. It may be that POS plans tended to grow more in certain types of cities, and in the near future POS enrollment will demonstrate an in-fill pattern similar to that shown by HMOs in general in the 1990s. Study of POS enrollment in MSAs would be beneficial, but there is also a need to study their enrollment and business practices on the individual, employer and provider levels.

---

[180] InterStudy uses 5 categories, Group, IPA, Mixed, Network and Staff, with over 80% of national HMO enrollment in either IPA or Mixed HMOs as of January 1997.

[181] Refer to MOS, SMFR and 1 or 2 others.

[182] InterStudy Edge, Spring 1988, p.9. InterStudy Competitive Edge 7.2, October 1997, p.6.

[183] A recent study published in JAMA indicates that less than 15% of POS enrollees take advantage of their option to self refer to any provider at all over the course of a year (AHL 2001).

*PPOs*

Preferred Provider Organizations (PPOs) constitute a promising area for further research.[184] HMOs have always been more aggressive in implementing managed care concepts, but PPOs have been an important alternative for at least 20 years. PPO enrollment grew more than twice as fast as HMO enrollment from 1987 to 1995 (Dranove et al 1998), and PPOs account for at least 50% of private insurance in the US (New York Times 1998). However, PPOs do not track their enrollees, providers and utilization as meticulously as HMOs do, which makes research difficult. And most states do not regulate PPOs, further limiting data availability (American Health Line 2001).

Therefore, the next step for analysis of PPO enrollment is to collect available data in geographically disaggregated form. InterStudy now conducts a PPO Census and plans on regularly releasing reports on PPOs. If reasonable estimates of PPO enrollment on the MSA level are available, then comparison of relative HMO and PPO strength is a promising area. Another desirable, but difficult, research area is comparison of PPO and HMO premiums and expenses. In particular, it would be interesting to compare PPOs' advantage in having lower administrative costs with their disadvantage in covering greater utilization at higher reimbursement rates.

[184] Some individual plans may tread on the boundary between HMO and PPO categories. However, there are clear legal and substantive distinctions between these 2 types of managed care. Legally, HMOs operate under HMO licenses in virtually all states. Substantively, HMOs employ elaborate payment and other mechanisms to influence provider behavior, employ primary care gatekeepers and collect substantial volumes of patient medical data. PPOs almost never do any of this (Lehnard 1999).

## D. Chapter Summary

This chapter explores the implications of the findings presented in Chapter 4. These findings strongly suggest that the relationship between the HMO industry and the physician profession changed between the mid-1970s and the early 1990s. This suggestion is consistent with research on the diffusion of innovations, which finds that diffusion strategies usually change as a product progresses from one life cycle stage to another.

The results of this study are of interest to policy makers and policy analysts for several reasons. The results suggest that minor changes in public policy at the state and local levels are unlikely to generate substantial increases in HMO enrollment. This is because the factors that are associated with HMO enrollment growth are intractable or unsuitable to influence by state and local policy levers. This study also provides systematic evidence that HMO enrollment tends to plateau. When this evidence is combined with the observed path of HMO enrollment at the national and state levels, the case that enrollment has plateaued and is unlikely to resume rapid growth becomes very strong.

The plateau in HMO enrollment may be reassuring to those concerned about HMOs' restriction of benefits or about possible arbitrary decisions denying coverage. As long as enrollment does not surpass current levels, most businesses and many individuals will have health insurance options other than HMOs. As a result, enactment of a federal Patients' Bill of Rights may be less urgent than it was perceived to be in the late 1990s.

The results of this study substantially improve upon the prior literature on factors associated with HMO growth. Prior studies of the 1970s found suggestions that the physician group practice and concentration of MDs variables were positively related to enrollment growth, but these results did not achieve statistical significance. In terms of the size of the coefficients, the results of this study are comparable with the prior results. However, here both variables are clearly statistically significant.

The results of this study complement those of prior studies on the effects of HMO growth, particularly findings concerning the geographic distribution of physicians and the reduction of hospital costs. Most notably, the combined evidence suggests that HMOs may have widened the gap between physician-sparse and physician-abundant cities, and this hypothesis deserves further research.

The results of this study suggest several other research projects. To understand the HMO industry, it would be helpful to rigorously test the hypothesis that HMO enrollment tends to plateau on the MSA level. Further research on HMO growth during the 1970s is warranted because the events of that era were crucial to the subsequent growth of the industry. It would be beneficial to understand why HMOs began operations in certain cities, but not others, during the 1973 to 1978 period. It would be worthwhile to test whether conditions in the nurse labor market affected financial arrangements between HMOs and hospitals. This chapter also recommends further analysis of HMO enrollment statistics, including analysis of enrollment in point of service (POS) plans and of enrollment broken down by HMO model type. Finally, the PPO industry, now much larger than the HMO industry, richly deserves

more research, including the development and analysis of geographically disaggregated enrollment statistics.

The most important conclusion from this chapter is that this study contributes to the literature on the economics of HMOs. It provides additional evidence for, and a fuller explanation of, the tendency of HMO enrollment to plateau. Additionally, the better understanding of the factors associated with HMO growth is likely to be helpful for future research on the HMO industry, including research on the effects of HMO growth.

This study was initiated in the belief that the HMO industry could help resolve national problems with health care costs and lack of access. For many, this prospect was attractive because HMOs applied entrepreneurial dynamism and flexibility to our hybrid public-private health sector. There is now strong evidence that HMOs did slow the growth of costs during the 1990s, but lack of access to health care remains as much of a problem as ever. The results of this study, which suggest that there were always serious limits to HMO growth, are consistent with the historical record that HMOs, and public policies oriented toward HMOs, have done little to expand health insurance.

However, once limits are understood, it becomes possible to devise new ways to transcend those limits. Our understanding of the history and performance of HMOs should be helpful in the development of public and private initiatives to resolve the continuing problems of high costs and lack of access.

Martin Markovich

RAND Graduate School

# THE RISE OF HMOs
## Appendices

Ph.D. Thesis

March 2003

## List of Appendices

# APPENDIX A
# DATA DEFINITION AND MEASUREMENT ISSUES

This appendix supplements Chapter 3, Research Methods and Data. That chapter features procedures for collecting and processing data on the outcome variable and on the 25 explanatory variables that were tested. This appendix goes into further detail on data definition and measurement for several variables. HMO Market Share, the outcome variable, is considered in section A1. Four inter-related hospital variables are addressed in section A2. Section A3 considers data definition and measurement for Average Years of Schooling. Section A4, the final section, addresses issues concerning estimates of Establishment Size.

In all cases, the unit of analysis is the Metropolitan Statistical Area (MSA), and the data set includes the best possible estimates for each variable for the 75 most populous MSAs in the U.S. as of 1990. As shown in Table 3-1, the Census Bureau classifies 18 large metropolitan areas, including the 12 most populous cities and Cleveland, Denver and Sacramento, as Consolidated Metropolitan Statistical Areas (CMSAs). Technically, each CMSA consists of 2 or more Primary Metropolitan Statistical Areas (PMSAs), and most Census Bureau statistics are provided for the PMSA level as well as the CMSA level. As a matter of convenience, the general policy in this report is to refer to all the included metropolitan areas as MSAs, or simply as cities, whether the Census Bureau officially classifies them as MSAs or CMSAs.

## A1. Allocating Enrollment of HMOs That Served More Than 1 MSA

In order to estimate total HMO enrollment for each metropolitan area (MSA), the enrollments for all the HMOs operating in that MSA were added. Therefore, this project required the most accurate possible estimates of enrollment for each HMO for each MSA or CMSA. For many HMOs, constructing such estimates was straightforward. These HMOs operated entirely within 1 MSA during a particular year, and InterStudy's estimate of enrollment is simply allocated to that MSA.

However, other HMOs operated in 2 or more MSAs during 1 or more of the analysis years, 1973, 1978, 1988 and 1993. A few HMOs operated in rural areas as well. InterStudy's general procedure was to allocate these HMOs' entire enrollment to the MSAs in which each HMO was headquartered. This was clearly unsatisfactory, and it was necessary to go through an enrollment allocation process.

Based on prior research (Baker 1994) the general algorithm was to allocate HMO enrollment proportional to the populations of the MSAs or other areas served by each HMO. However, in some cases, available information indicated that enrollment was not likely to be distributed proportional to MSA population. For example, some HMOs only operated in a sub-set of the counties of a particular MSA. In such cases, enrollment was allocated proportionally to the population of the counties in which the HMO operated rather than proportionally to the entire MSA population. In other cases, there is clear evidence that the HMO's provider network and enrollment was concentrated in one MSA and that service in another MSA had only recently been added on a trial basis. In those cases, the estimated enrollment in the new MSA was downweighted relative to population, frequently by a factor of 50%.

The adjustments had the effect of increasing the HMO market share of some cities and decreasing it for others. Estimated HMO market share did not drastically change for most MSAs. Most of the adjustments involved less than 1% of an MSA's population.
Probably the most significant changes were made for the Sacramento area. About 170,000 Kaiser enrollees were "transferred" from San Francisco to Sacramento for 1973, and about 243,000 were similarly reallocated for 1978. Thus, Sacramento's HMO market share went about by almost 20% for 1973 and by over 23% for 1978 as a result of these reallocations. In terms of rank, Sacramento moved from the middle of the pack for both years to having the greatest HMO market share for 1973 and the 2nd greatest for 1978.

The following paragraphs provide additional detail on the specific adjustment processes used for each of the 4 analysis years.

*1973*
Available evidence indicates that there were only 2 HMOs in 1973 that operated in more than 1 MSA. These were the 2 Kaiser plans in California, Kaiser Permanente Northern California and Kaiser Permanente Southern California. Historical county-level enrollment information was available directly from the staff of these 2 plans, and this data was used to generate the MSA-specific enrollment estimates for the 2 Kaiser plans for 1973.

*1978*
InterStudy's 1978 enrollment report, which was officially released by the Federal government[1], lists HMOs by state of headquarters, and it does not indicate whether each HMO operated in more than 1 MSA at that time. However, in 1982, InterStudy released "Cities Served By HMOs", which lists all the HMOs operating in each U.S. metropolitan area at that time. "Cities Served By HMOs" also shows the initial operating date of each HMO. If an HMO with enrollment in more than 1 MSA in 1982 was operational in 1978, it was usually assumed that the HMO operated in the same MSAs in 1978 as in 1982.

Using this approach, I found 17 HMOs that were likely to be operating in more than 1 MSA in 1978. These included the 2 California Kaiser plans, 4 other plans operating in California, 6 plans operating in the Northeast and 4 plans operating in the Midwest. For 1978, direct enrollment data was available for Kaiser Southern California, but not for Kaiser Northern California. Kaiser Northern California enrollment was allocated proportionally to the populations of the MSAs.

The enrollments of the other 15 HMOs were allocated according to an appropriate proportional weighting rule. In several cases, the HMO was headquartered in one of the 75 MSAs included in this study, but it also operated in an MSA or rural area not included in this study's data set. Therefore, the net effect of the adjustments made for those cases was to slightly reduce estimated total HMO enrollment for the 75 MSAs.

*1988*
For 1988, it was found that 10 HMOs, including 3 Kaiser plans, needed enrollment allocation across MSAs or other areas. Because the HMO industry changed so much between 1978 and 1988, most of the plans whose enrollments were reallocated for 1978 did not need to have their enrollments

[1] U.S. Department of Health, Education and Welfare "National Census of Prepaid Health Plans 1978", mimeographed report.

reallocated for 1988 and vice versa. Some of the HMOs that were reallocated for 1988 were HMO Colorado, Ochsner of Louisiana and Health Maintenance Plan headquartered in Cincinnati, Ohio.

The 1988 enrollments for most of these plans were reallocated according to an appropriate proportional weighting rule. The main exception was Health Options of Florida. Health Options only reported total enrollment for the entire state. Health Options enrollment was allocated proportionally to the square of the population of numerous Florida MSAs. Additional evidence strongly suggested there was no HMO enrollment in the Sarasota-Bradenton MSA in 1988, so none of the Health Options enrollment was allocated to Sarasota-Bradenton.

*1993*

For 1993, I was able to secure an internal InterStudy database, maintained in an Excel spreadsheet, which included InterStudy's estimates of MSA enrollments for individual HMOs.[2] This internal database, with data for over 500 plans, provided a great deal of valuable information, but it also included several obvious errors (such as listed percentages adding to less than 50%) and numerous apparent errors (such as inconsistencies with InterStudy Competitive Edge published for the same date, July 1, 1993).

Whenever the internal database appeared to be accurate and consistent, it was used to adjust MSA level enrollment estimates. In a number of cases, the internal database did not appear to be useful, and enrollment for those HMOs was generally allocated according to the proportional weighting rule. In several cases, the internal database appeared to have some good information, but it was marred by an apparent typographical or arithmetic error. In those cases, common sense was used to settle on the most reasonable set of estimates. The published report does list Counties served for each HMO, and this information was useful in applying proportional weights.

## A2 Definition and Measurement Issues for Hospital Variables

Because of the central role that hospitals play in our health care system, 4 variables describing the supply, utilization and expense of hospital services at the MSA level are included in the statistical analysis. The 4 hospital variables are: a) the number of hospital beds per capita, b) the utilization of hospital bed-days per capita, c) charges per bed-day and d) hospital charges per capita. This section describes these variables, and it addresses major measurement issues concerning them. It also compares the definitions of these 4 variables for the 2 analysis periods, 1973-1978 and 1988-1993.

*1973-1978 Period*

The Area Resources File (ARF) offers measures of hospital beds and bed-day utilization for the year 1973. The ARF data for these 2 variables only includes general hospitals, which is appropriate. In accord with the growth prediction method described in Chapter 3, hospital beds and bed-days are tested as explanatory variables of HMO growth for the 1973-78 period. These 2 variables did show a very high correlation (.95), and it would have been very difficult to distinguish their statistical associations with HMO market share had the analysis revealed such associations.

---

[2] InterStudy planned on releasing estimates of total HMO enrollment by MSA. They started releasing those estimates with their report for January 1, 1994, and they have been releasing them regularly since.

The ARF was also used to generate data for 2 measures of hospital costs, charges per bed-day and hospital charges per capita. For the earlier period, the ARF only offers a single figure for combined general and special hospital costs for each county for 1975. This single figure also combines inpatient and outpatient costs. The county figures have been aggregated to the MSA level.

The estimate for charges per bed day was generated by dividing the ARF's total hospital costs figure by total general hospital bed-days in 1973. 1973 was the only year for which any estimate of hospital bed-days was available, and the inconsistency in the years of the numerator and denominator is a minor problem. But the inconsistency of dividing combined general and special hospital charges by general hospital bed-days constitutes a more serious incompatibility of the numerator and denominator. A related flaw is that the inclusion of outpatient charges further reduces the accuracy of these estimates of charges per bed day. These problems mean that the dollar figure per bed-day is not meaningful per se, and analysis and interpretation based on results generated using this variable should be approached with caution. But this variable may still be a reasonable index for comparing hospital expenditures per hypothetical unit of service across MSAs.

Most of the problems of estimating costs per bed-day do not apply to estimates of hospital expenses per capita. In principal, including special hospital expenses and general hospital outpatient expenses is appropriate in measuring costs per capita. Additionally, the numerator and denominator are taken for the same year, 1975. Therefore, this variable is more reliable, and it is a legitimate measure of hospital expenses at the MSA level. However it is fairly highly correlated with the variable for beds per capita (.67) and hospital days per capita (.65).

*1988-1993 Period*

The same basic set of hospital variables have been generated for the 1988-1993 period. The measure for hospital beds per capita and hospital days per capita are based on 1989 data, and they are both fully comparable with the 1973 estimates.

For the hospital expenditure variables, the ARF offers total general hospital expenditures for each county for the year 1990. Thus, hospital charges per day for this period is estimated by consistently using general hospital data, making for a much more credible set of estimates. There is still a slight inconsistency in this data because the numerator (hospital charges) is for the year 1989, while the denominator (hospital bed-days) is for the year 1990. Additionally, it is believed that the numerator still includes outpatient as well as inpatient charges. However, the 1989/90 estimates for hospital costs per day are much more credible than those for 1975/73 since the later estimates are consistently based on data only for general hospitals.

Similarly, the 1990 estimates of hospital charges per capita are based only on general hospital charges, whereas the 1975 estimates used the sum of general and special hospital costs. The 1990 estimates are valid, just not completely consistent with the 1975 estimates. Additionally, the 1990 estimates for hospital charges per capita have very high correlations (>.8) with the 1989 estimates for hospital beds per capita and hospital bed-days per capita.

### A3 Average Years of Schooling

The ARF includes a measure of Median Years of Schooling for every county for the year 1980. ARF documentation indicated that this variable was measured to 1 decimal place (i.e. to tenths of a school year), and the intention was to use this variable to test for a relationship between median

schooling and HMO growth during the 1973 to 1978 period. However, the median years of schooling estimates for 36 of the 46 MSAs worked out to exactly 12.0. It is not clear if this is because high school graduation was the median level of schooling for all these MSAs or because the data for many of the observations was truncated. In any case, there wasn't enough variability within this variable for it to be useful in the 1973 to 1978 multiple regression analysis.

For the 1988 to 1993 period, a different source and a different method were used to estimate average schooling at the MSA level. Average schooling in 1989 was estimated from census data showing the numbers of persons age 25 and above with various levels of educational attainment for each city. The 7 categories ranged from less than the completion of 9$^{th}$ grade to completion of a graduate or professional degree. An estimated average number of years of schooling was imputed for each of the categories, and these averages were used to construct a weighted average for each of the 75 MSAs. No special problems or issues arose with this method.

### A4 Establishment Size

Establishment size, i.e. the number of employees per private working establishment, was hypothesized to affect HMO growth at the MSA level. This variable is also referred to as firm size in the main text.

Data classifying private establishments by number of employees was available from the census publication County Business Patterns. For the 1973 to 1978 period, the best available data was for the census year 1980. The data listed the number of establishments in each county falling into each of 9 establishment size categories. The smallest category was 1 to 4 employees, and the largest was 1,000 or more employees. This data was aggregated to the MSA level, and an estimated average establishment size was imputed for each category. This permitted the construction of a weighted average establishment size for each MSA.

For the 1988 to1993 period, the analogous census data for 1990 was used, and the method for constructing estimated average establishment size was mathematically identical. However, the collection and processing of the 1990 data was completed far more expeditiously because it was possible to download the necessary data from the Internet onto an Excel spreadsheet.

There are several limitations to the estimates for establishment size. The Census Bureau's exclusion of government establishments and of self employed persons made the data less accurate and useful for the purposes of this study. For private companies, defining exactly what constitutes an establishment requires the application of specific rules, and the formulation and application of these rules by the Census Bureau may be subject to question. The years for which it would have been best to have data would have been 1978 and 1993, so the use of 1980 and 1990 census data further detracts from the data's accuracy. The imputation of the same estimated average size for each of the 9 categories creates another possible source of error.

Overall, the weighted average estimates appear to give some useful information about establishment size. However, because of the several potential sources of error, it is possible that one or more estimates of MSA average establishment size include substantial measurement error.

# APPENDIX B
# REGRESSION DIAGNOSTICS

This appendix consists primarily of plots of residuals and tables of diagnostic statistics for both the 1970s and 1990s.[3] It supports the brief discussion of regression diagnostics at the end of Chapter 3 and the presentation of diagnostic results at the end of Chapter 4. Section C of Chapter 4 includes Table 4-11, which features the most influential cases revealed by the diagnostic analysis. Section B1 covers the final 1970s model and Section B2 covers the final 1990s model. Both of the sections begin with about a page and a half of text. Figures and tables follow the text.

## B1. Diagnostics for the 1970s

This section exclusively refers to the final 1970s model, the results of which are presented in Chapter 4 (Table 4-6 and Subsection B3 of that chapter).

Figure B1 shows the studentized residuals for the 1970s analysis (F3rst) plotted against the predicted outcome values for the 1973-78 period (F3y). The units of the residuals are essentially the same as those for the outcome variable – percentage points of total MSA population. Each of the 46 MSAs included in this analysis have been numbered, and the MSA numbers, along with values for Cook's Distances and dfbetas, are shown in Table B1.[4]

Figure B1 and the diagnostic statistics both show that the residuals are normally distributed, independent of predicted y values and independent of each other. There is little indication of heteroscedasticity here. The small degree of clustering apparent in Figure B1 is most likely a consequence of the small size of the data set, not of any non-linear relationships between the outcome and explanatory variables.

The standard deviation (SD) of the studentized residuals is 1.04 and none of the residuals have an absolute value greater than 3 SDs. Of the 46 observations, 3 cities have absolute residual values greater than 2 SDs. These are #15 Omaha, with a residual of –2.41 (z=-2.32), #41 Portland, with a residual of 2.34 (z=2.26) and #1 Las Vegas, with a residual of -2.13 (z=-2.05).[5]

Figure B2 shows the residuals (F3rst) plotted against the first of 4 explanatory variables, percent of physicians in group practice (StGr75p). This figure shows that the distribution of the group practice explanatory variable is somewhat skewed, but the residuals themselves are independent of this explanatory variable. Figure B3 shows the residuals plotted against the MDs per capita explanatory variable (MDPC). Figure B4 shows residuals plotted against RNs per capita (RNsPC). Figure B5 shows residuals plotted against Latitude (RelLat). Like Figure B2, Figures B3, B4 and B5 show that the residuals are independent of the respective explanatory variables.

---

[3] The full version of Appendix B runs 18 pages and includes 10 figures generated using Stata Release 4. Because of technical difficulties, the figures are not included in the electronic version of the complete set of Appendices formatted in Word 2000. Hard copies of the figures are available from the author.

[4] For this period, the order in which the observations are numbered does not bear any significance.

[5] These are also the 3 cities with the highest values for Cook's distance. The reasons for, and implications of, their influential point status are discussed in Chapter 4, Table 4-11.

Table B1, besides providing the MSA numbers used in Figures B1 – B5, lists the Cook's distances and the 4 dfbetas for all 46 observations. Cook's distance provides a measure of the overall influence of each observation on the coefficient values of the final 1990s model. The 4 sets of dfbeta values, one each for Group Practice, MDs per capita, RNs per capita and Latitude, estimate the change in the t statistic for each coefficient if that particular observation were excluded.

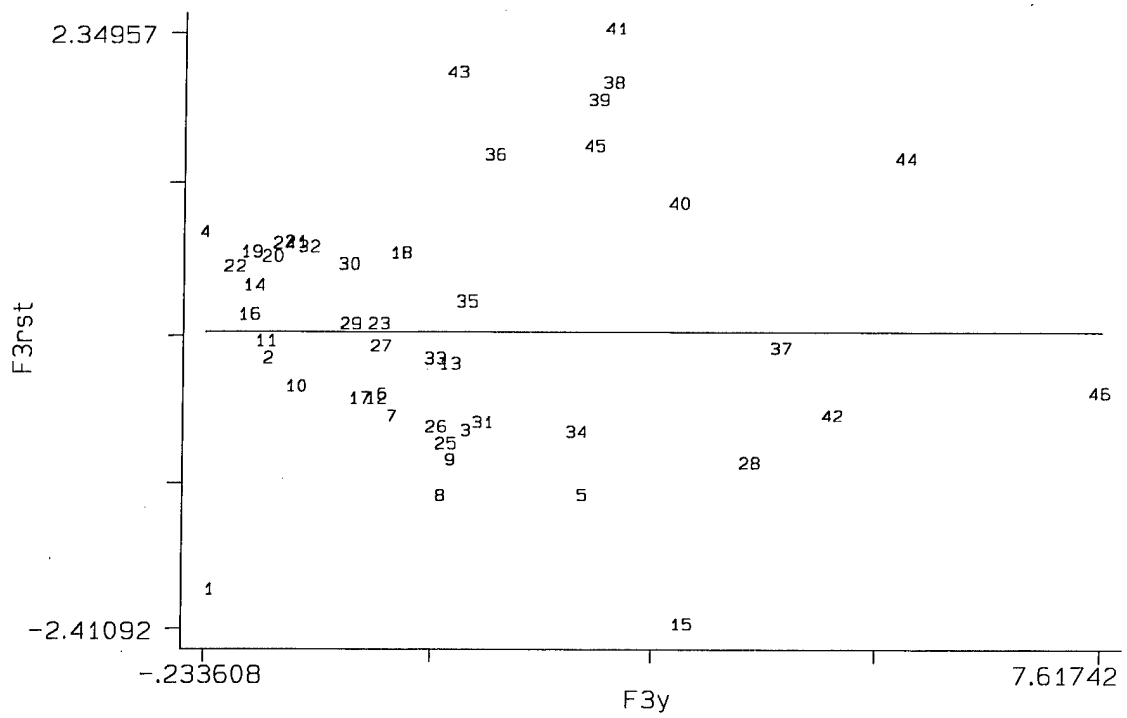
There is no consensus concerning the critical value for a dfbeta statistic, but any critical value should be applied to the absolute value. The literature includes suggestions that $2/\sqrt{n}$ (which equates to .295 for this regression) or simply 1.0 be used.[6] In this set of dfbeta values, there are none whose absolute value exceeds 1.0. There are 16 dfbetas in excess of .295, and 5 of these exceed .50. Three of the values in excess of .50 reflect the influence of Honolulu, Miami and Seattle on the Latitude coefficient, and these fairly high values are not surprising.

The dfbeta with the largest magnitude is -.785 for the influence of Omaha on the RNs per capita coefficient. As pointed out in Table 4-11, if Omaha is eliminated from the data set, the t statistic for RNs rises from 3.7 to almost 4.5. Therefore this diagnostic analysis tends to confirm the finding that concentration of nurses had a significant effect on HMO growth from 1973 to 1978. Lastly, a dfbeta of .570 shows the influence of Las Vegas on the coefficient of MDs per capita. This is also discussed in Table 4-11.

In conclusion, regression diagnostic analysis supports the validity of the final 1970s model. Where the analysis shows moderate outliers and influential points, their effects have been considered and appropriate caveats are included in the main text.

[6] Stata Corporation, Reference Manual, Stata Press, Release 4, 1995, p.394.

# Figure B1
# 1970s Plot of Residuals vs. Fitted Values



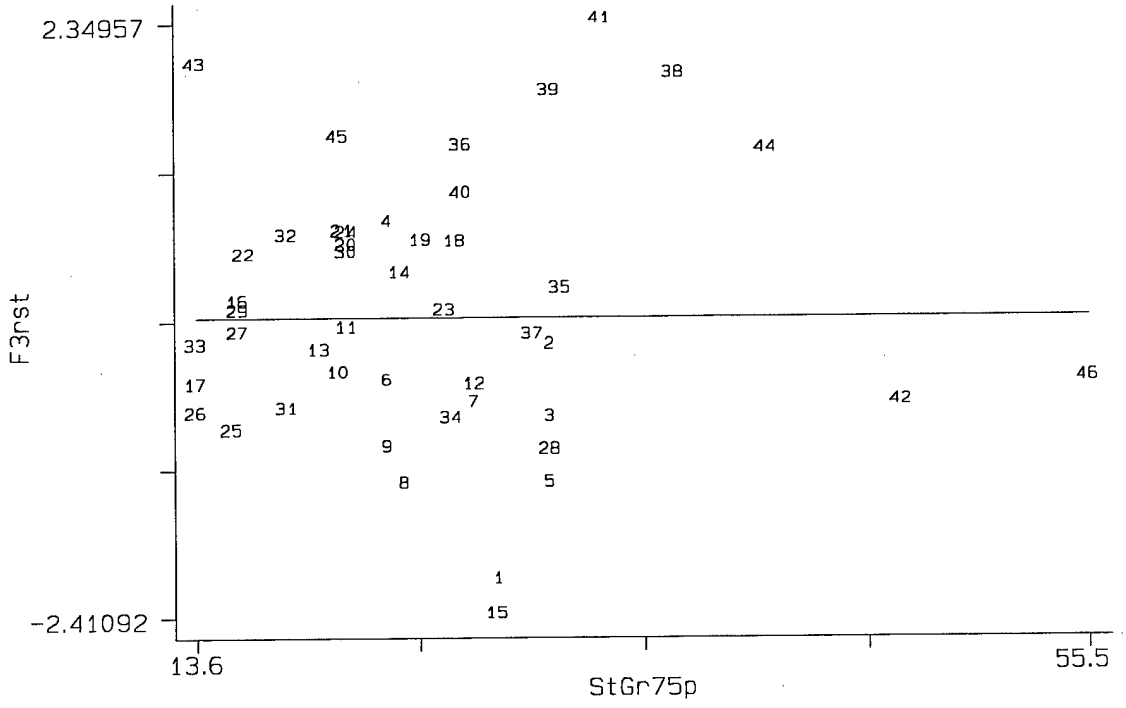
# Table B1
## 1970s MSA Numbers and Diagnostic Values
### Cook's Distances and dfbetas

| | | | dfbeta | dfbeta | dfbeta | dfbeta |
|---|---|---|---|---|---|---|
| | | Cook's | Group | MDs | RNs | Latitude |
| Num | MSA Name | Distance | Practice | per capita | per capita | |
| | | | | | | |
| 1 | Las Vegas | .13610 | .00783 | .57041 | .30345 | -.23581 |
| 2 | Bakersfield | .00189 | -.01008 | .04915 | .04568 | -.02557 |
| 3 | Sacramento | .00808 | -.06597 | -.03658 | .12934 | -.08569 |
| 4 | El Paso | .01634 | -.06419 | -.19861 | -.02301 | -.04827 |
| 5 | Los Angeles | .02704 | -.13086 | -.21536 | .15582 | .07498 |
| 6 | San Antonio | .00519 | .03000 | .02493 | .00703 | .09730 |
| 7 | Kansas City | .00390 | -.01325 | .04961 | .04437 | -.05750 |
| 8 | Birmingham | .02654 | .04405 | -.20348 | .19830 | .06975 |
| 9 | Houston | .02072 | .04820 | -.09733 | .06326 | .19192 |
| 10 | Tampa-St. Pete | .00969 | .05109 | .13327 | -.07070 | .13081 |
| 11 | Columbus | .00012 | .00992 | .00759 | .01033 | -.01286 |
| 12 | St. Louis | .00458 | -.00575 | -.03362 | .11982 | -.07544 |
| 13 | Albuquerque | .00127 | .02495 | -.05301 | .02335 | .01910 |
| 14 | Detroit | .00222 | -.01939 | .00004 | -.07696 | .08018 |
| 15 | Omaha | .15028 | -.25717 | .22731 | -.78490 | .23103 |
| 16 | Allentown | .00037 | -.01628 | -.03211 | .02356 | -.00112 |
| 17 | Syracuse | .00692 | .09716 | .02117 | -.08326 | -.01747 |
| 18 | Salt Lake City | .00486 | .00240 | .05849 | -.11653 | .09417 |
| 19 | Greenville | .00705 | -.02829 | -.13907 | -.01739 | .00142 |
| 20 | Louisville | .00281 | -.05068 | -.03586 | -.05007 | .04066 |
| 21 | Chicago | .00641 | -.05967 | .03872 | -.11938 | .12115 |
| 22 | Providence | .00315 | -.07819 | .00076 | -.04839 | .06868 |
| 23 | Indianapolis | .00001 | -.00019 | .00173 | -.00467 | .00351 |
| 24 | Cincinnati | .00395 | -.05838 | -.01774 | -.07452 | .06591 |
| 25 | Hartford | .01912 | .12092 | .02120 | -.19437 | .03717 |
| 26 | New York | .02068 | .13793 | -.23586 | .05901 | -.02417 |
| 27 | Pittsburgh | .00057 | .02095 | .02321 | -.03704 | .00929 |
| 28 | San Francisco | .03661 | -.15092 | -.37039 | .06941 | .05924 |
| 29 | Philadelphia | .00001 | -.00364 | .00184 | -.00054 | .00086 |
| 30 | Cleveland | .00428 | -.03922 | .07316 | -.10085 | .08265 |
| 31 | Boston | .00966 | .06697 | -.11342 | -.02270 | -.03431 |
| 32 | Springfield | .01298 | -.07233 | -.18486 | .14819 | .01294 |
| 33 | Albany | .00198 | .03929 | .01245 | -.06553 | .01099 |
| 34 | Wash.-Balt. | .01136 | -.02967 | -.19557 | .07977 | -.02894 |
| 35 | Greensboro | .00058 | .01810 | -.03649 | .01141 | -.00612 |
| 36 | Phoenix | .01765 | .03410 | -.10745 | .11897 | -.18382 |
| 37 | Denver | .00068 | -.02381 | -.01703 | -.03691 | .01926 |
| 38 | Seattle | .11607 | .41521 | .08706 | -.17652 | .54911 |

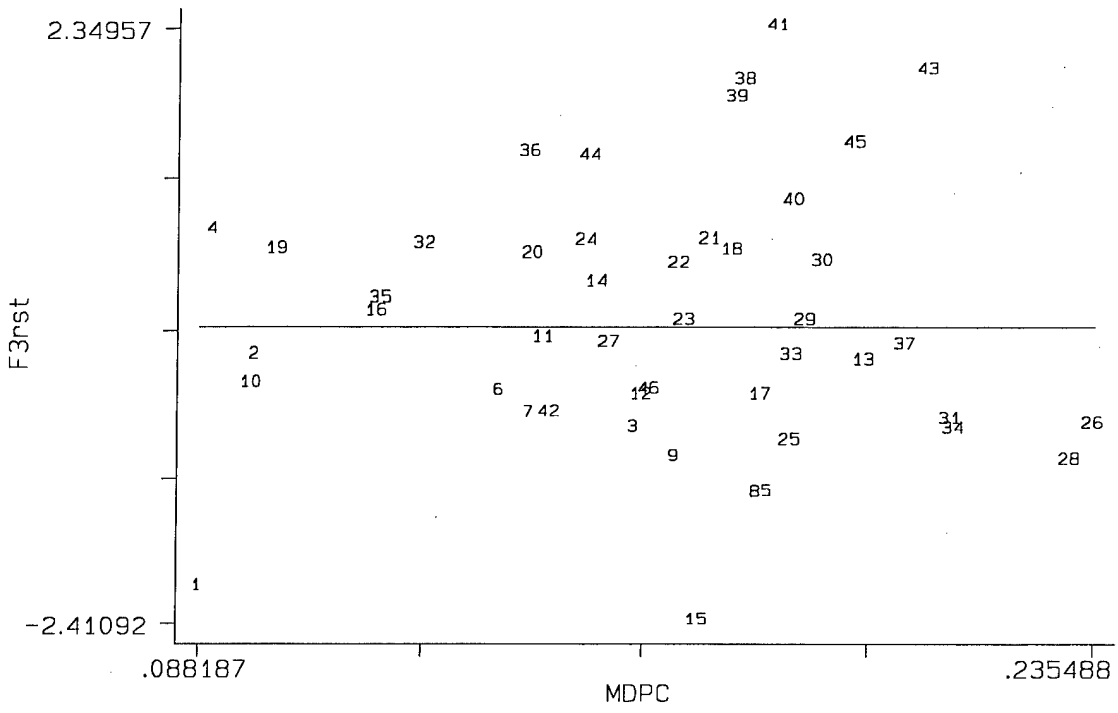
Table B1 (continued)

| | | | Dfbeta | Dfbeta | Dfbeta | dfbeta |
|---|---|---|---|---|---|---|
| | | Cook's | Group | MDs | RNs | Latitude |
| Num | MSA Name | Distance | Practice | per capita | per capita | |
| | | | | | | |
| 39 | San Diego | .04273 | .17515 | .23011 | -.12178 | -.18575 |
| 40 | Tucson | .01916 | .05852 | .08586 | .16138 | -.24871 |
| 41 | Portland | .09857 | .37410 | .12320 | -.05021 | .43191 |
| 42 | Milwaukee | .02704 | -.31185 | .07626 | -.08392 | -.06986 |
| 43 | Rochester | .09797 | -.30843 | .14984 | .32753 | -.00706 |
| 44 | Honolulu | .17391 | .46224 | .08252 | .28943 | -.77990 |
| 45 | Miami | .09608 | -.08193 | .29862 | .11206 | -.57579 |
| 46 | Minn.-St. Paul | .03882 | -.39000 | .04097 | -.14841 | -.04066 |

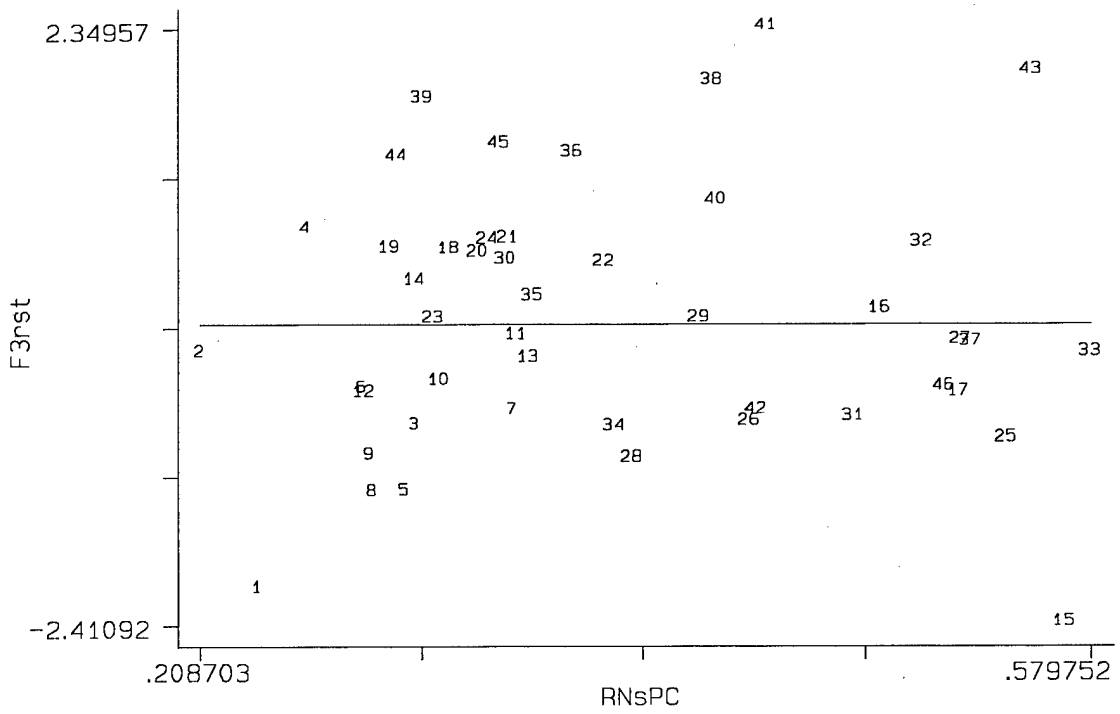
# Figure B2
# 1970s Plot of Residuals vs. Group Practice Variable



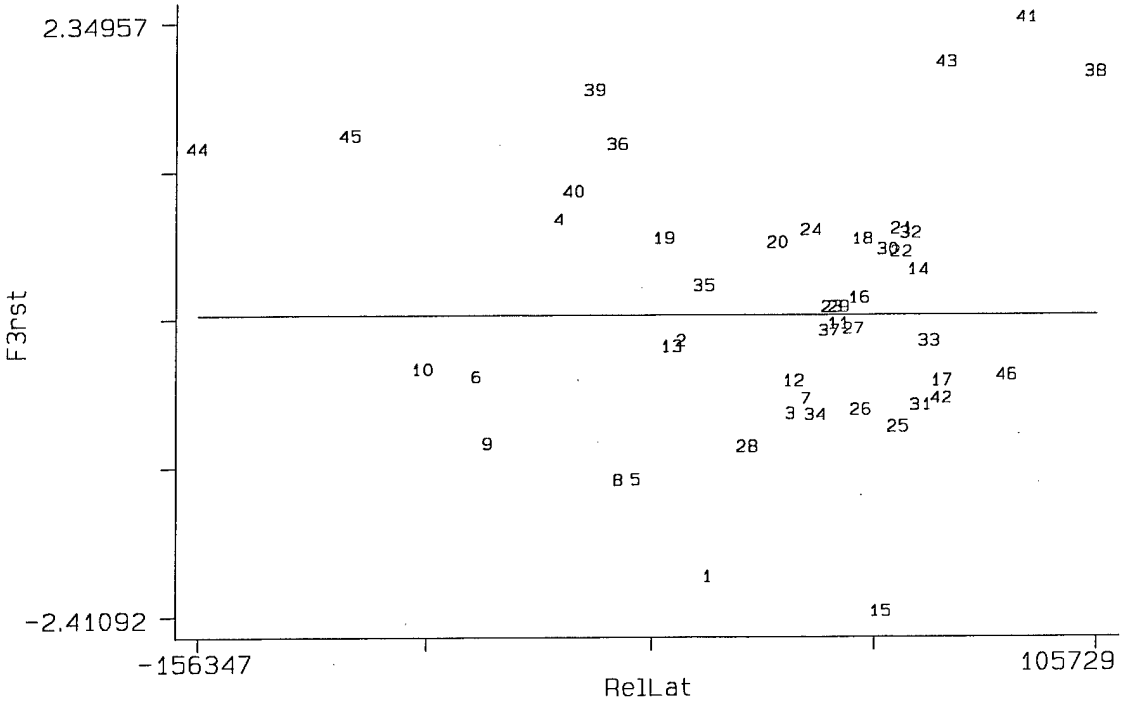
# Figure B3
# 1970s Plot of Residuals vs. MDs per capita



# Figure B4
# 1970s Plot of Residuals vs. RNs per capita



# Figure B5
# 1970s Plot of Residuals vs. Latitude Variable



## B2. Diagnostics for the 1990s

This section exclusively refers to the final 1990s model, the results of which are presented in Chapter 4 (Table 4-9 and Section B7 of that chapter).

Figure B6 shows the residuals for the 1990s analysis (Dmres) plotted against the predicted outcome values for the 1988-93 period (DMy).[7] Again, the units of the residuals are percentage points of total MSA population. Each of the 75 MSAs included in this later analysis have been numbered, and the MSA numbers, along with values for Cook's Distances and dfbetas, are shown in Table B2. For this period, the MSAs are numbered by the value of Cook's Distance, with the MSAs with the lowest Cook's Distances coming first.

Figure B6 and the diagnostic statistics both show that the residuals are normally distributed, independent of predicted y values and independent of each other. Specifically, there is little indication of heteroscedasticity in these residuals. The standard deviation (SD) of the residuals is 5.64, and none of the residuals have an absolute value greater than 3 SDs. Three cities have residuals with values greater than 2 SDs. These are #74 Indianapolis with a residual of –15.56 (z=-2.76), #73 Dayton with a residual of 13.36 (z=+2.37) and #72 Syracuse with a residual of –12.19 (z=-2.16).[8]

Figure B7 shows the residuals (Dmres) plotted against the first of 4 explanatory variables, percent of physicians in group practice (StGr88p). This figure shows that the distribution of the group practice explanatory variable is somewhat skewed, but the residuals themselves are independent of this explanatory variable. Figure B8 shows the residuals plotted against the economic growth explanatory variable (EG7893). Figure B9 shows residuals plotted against MDs per capita (MDPC89).

Like Figure B7, Figures B8 and B9 show that the residuals are independent of the respective explanatory variables. The last of the figures, B10, shows the residuals plotted against the eastern Midwest dummy variable (Big10Dum). This figure highlights the presence of 2 outliers, Indianapolis and Dayton, among the eastern Midwest cities. Otherwise, Figure B10 indicates that residual values are independent of this dummy variable.

Table B2, besides providing the MSA numbers used in Figures B6 – B10, lists the Cook's distances and the 4 dfbetas for all 75 observations. Cook's distance provides a measure of the overall influence of each observation on the coefficient values of the final 1990s model. The 4 sets of dfbeta values, one each for Economic Growth, Group Practice, MDs per capita and the east Midwest dummy variable, estimate the change in the t statistic for each coefficient if that particular observation were excluded.

---

[7] The figures for the 1990s show simple residuals, unlike the figures for the 1970s that show Studentized Residuals. However, for these datasets the difference is very small.

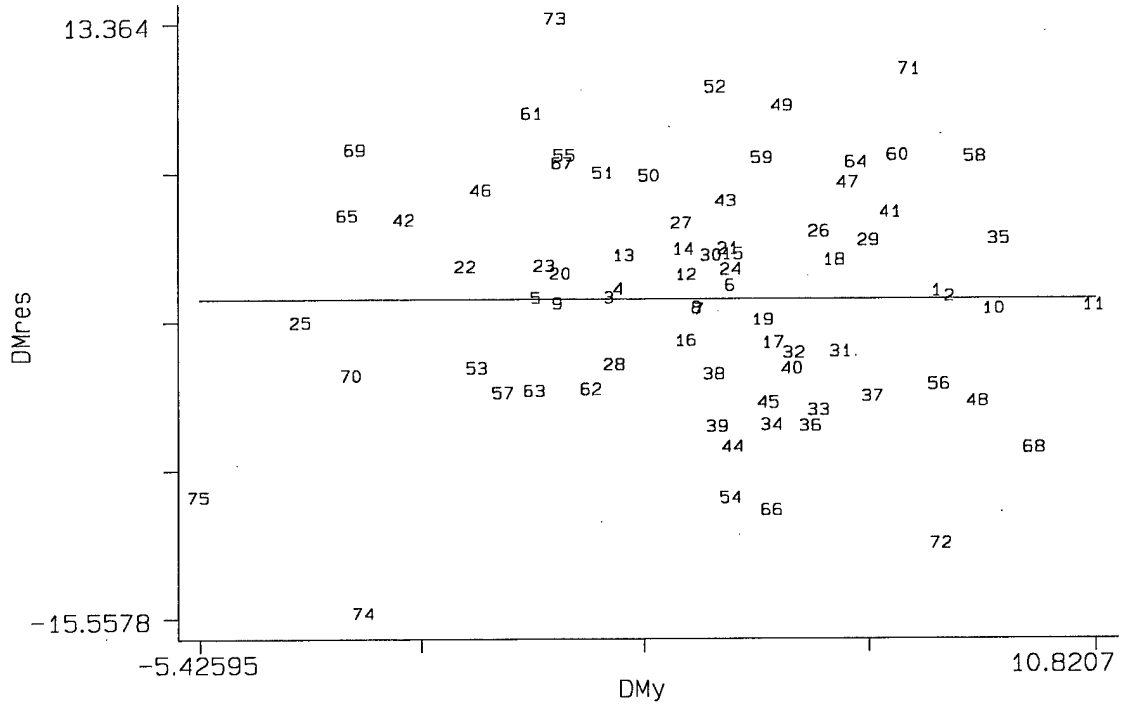
[8] As discussed in Chapter 4, Indianapolis was the city with the greatest decline in HMO market share from 1988 to 1993, while Dayton was the eastern Midwest city with the greatest growth in market share. Syracuse was a Northeastern city that bucked the trend and saw a decrease in market share during this period. Market share in Syracuse went down by 4.10% while it grew robustly in Albany and Rochester, the 2 closest cities in this dataset.

There is no consensus concerning the critical value for a dfbeta statistic, but any critical value should be applied to the absolute value. The literature includes suggestions that $2/\sqrt{n}$ (which equates to .231 for this regression) or simply 1.0 be used.[9] In this set of dfbeta values, there is only one whose absolute value exceeds 1.0. That is the dfbeta for the influence of Raleigh-Durham on the coefficient of MDs per capita. This influential observation is discussed in Chapter 4. There are 17 other dfbetas with absolute values in excess of .231, but only 2 with absolute values greater than .50. Those 2 reflect the influence of Indianapolis and Dayton on the coefficient for the east Midwest dummy, as discussed in Chapter 4.

In conclusion, examination of residuals and diagnostic statistics confirms that regression assumptions are correct for the final 1990s model. Where the diagnostic analysis shows outliers or influential points, their effects have been considered and appropriate caveats are included in the main text.

[9] Stata Corporation, Reference Manual, Stata Press, Release 4, 1995, p.394.

# Figure B6
# 1990s Plot of Residuals vs. Fitted Values



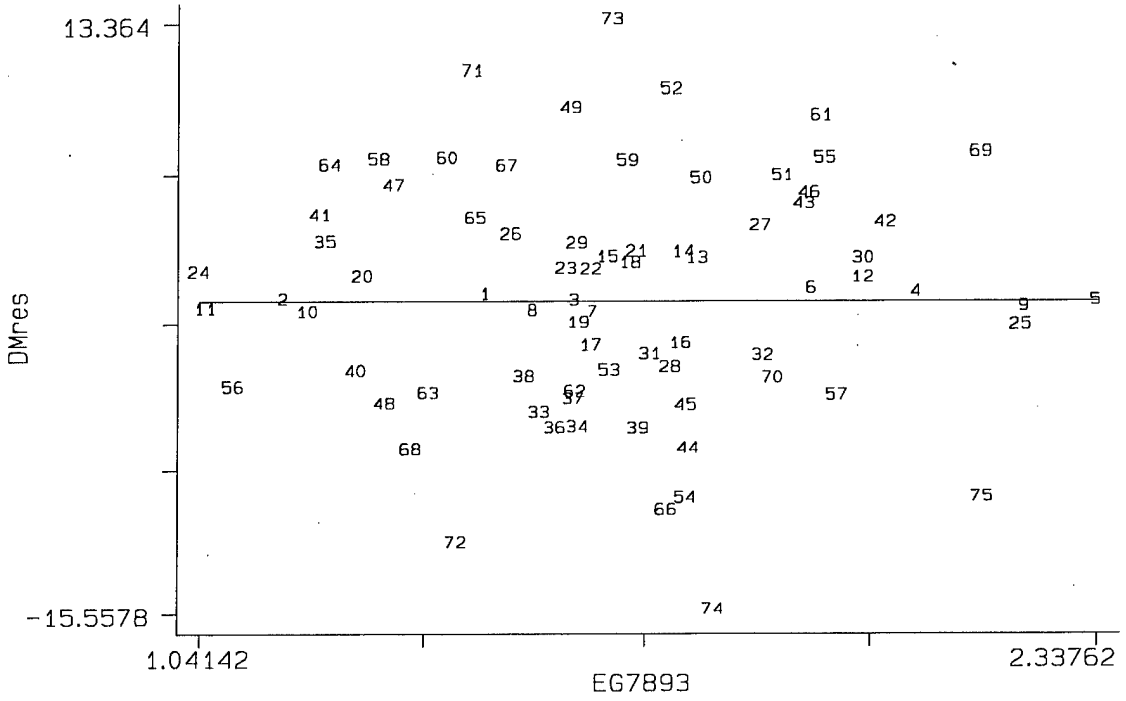
# Table B2
## 1990s MSA Numbers and Diagnostic Values
## Cook's Distances and dfbetas

| Num | MSA Name | Cook's Distance | dfbeta Econ. Growth | dfbeta Group Practice | dfbeta MDs per capita | dfbeta East Midwest |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | Austin | .000005 | -.00158 | -.00134 | -.00321 | -.00141 |
| 2 | Wash.-Balt. | .000010 | .00421 | .00240 | -.00387 | .00116 |
| 3 | Seattle | .000015 | .00258 | -.00762 | -.00113 | .00334 |
| 4 | Atlanta | .000026 | .00888 | -.00346 | -.00444 | .00011 |
| 5 | W. Palm Beach | .000030 | -.01069 | .00528 | .00352 | -.00148 |
| 6 | Tampa-St. Pete | .000060 | .01048 | -.00892 | -.00880 | .00003 |
| 7 | Norfolk | .000073 | .00491 | -.00870 | -.00532 | .00832 |
| 8 | Richmond | .000099 | .00958 | -.00976 | -.01275 | .00853 |
| 9 | Sarasota | .000135 | -.02222 | .01178 | .00519 | -.00276 |
| 10 | Buffalo | .000293 | .02252 | .01741 | -.01139 | .00664 |
| 11 | Bakersfield | .000318 | .02743 | -.01079 | .02059 | .01404 |
| 12 | Jacksonville | .000342 | .02888 | -.02110 | -.01712 | .00140 |
| 13 | Charleston | .000511 | .00796 | .01393 | .02256 | -.01495 |
| 14 | St. Louis | .000522 | .01155 | -00282 | .01030 | -.01391 |
| 15 | Sacramento | .000527 | -.00766 | .02265 | -.01289 | -.02238 |
| 16 | Denver | .000545 | -.01135 | .00331 | -.01044 | .01427 |
| 17 | Kansas City | .000570 | .00790 | .00090 | .00877 | .02068 |
| 18 | Tulsa | .000591 | .00706 | -.01715 | -.03740 | -.01063 |
| 19 | New York | .000799 | .00264 | .03530 | -.03774 | .00180 |
| 20 | Detroit | .000835 | -.02145 | .02061 | .00417 | .04270 |
| 21 | Phoenix | .000956 | -.00198 | .03154 | -.03192 | -.02644 |
| 22 | Chicago | .001361 | .01370 | -.01635 | .015546 | .07485 |
| 23 | Columbus | .001389 | .01319 | -.01941 | -.01082 | .07580 |
| 24 | Toledo | .001487 | -.04342 | -.00394 | .01178 | .05567 |
| 25 | Nashville | .001524 | -.04586 | -.05070 | -.02282 | .01137 |
| 26 | Miami | .001680 | -.03304 | -.03168 | .03211 | -.02313 |
| 27 | Greensboro | .001849 | .05140 | -.01478 | -.03263 | -.01593 |
| 28 | Tucson | .002097 | .00121 | -.05755 | -.04069 | .03707 |
| 29 | Albany | .002105 | .00298 | -.08159 | -.00155 | -.00440 |
| 30 | Las Vegas | .002348 | .05723 | -.01048 | -.08489 | -.00709 |
| 31 | Charlotte | .002770 | -.01777 | .01452 | .09824 | .02200 |
| 32 | Orlando | .003275 | -.06026 | .06191 | .08740 | .00377 |
| 33 | Houston | .004029 | .04275 | .04215 | -.00481 | .04530 |
| 34 | Honolulu | .004147 | .03245 | -.00169 | .00568 | .05831 |
| 35 | Stockton | .004383 | -.09008 | .04319 | -.08108 | -.05477 |
| 36 | Oklahoma City | .004775 | .03877 | .03848 | .01057 | .05231 |
| 37 | Dallas | .005207 | .00719 | .05527 | .10494 | .03666 |
| 38 | New Orleans | .005312 | .05263 | .00524 | -.12712 | .03472 |

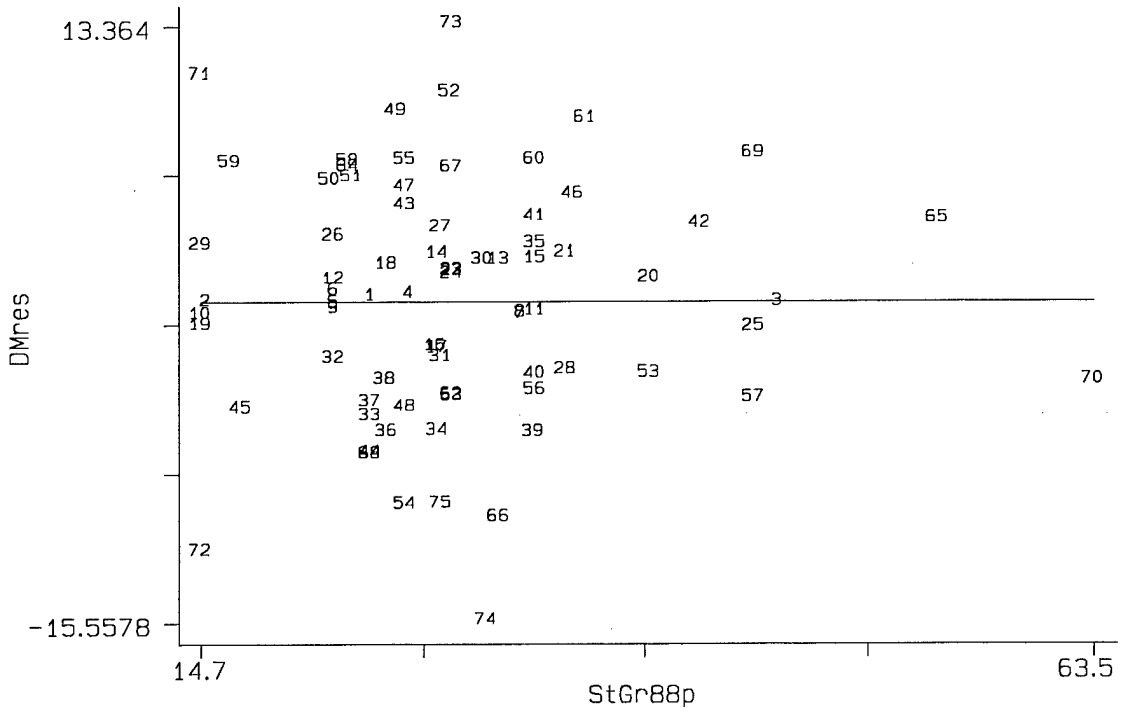
Table B2 (continued)

| Num | MSA Name | Cook's Distance | dfbeta Econ. Growth | dfbeta Group Practice | dfbeta MDs per capita | dfbeta East Midwest |
|---|---|---|---|---|---|---|
| 39 | Wichita | .005724 | .00362 | -.06902 | .05065 | .06939 |
| 40 | San Francisco | .006469 | .13059 | -.08044 | -.09137 | .06848 |
| 41 | San Diego | .006586 | -.14798 | .07980 | .01281 | -.07911 |
| 42 | Omaha | .006672 | .06883 | .11576 | .06300 | -.03619 |
| 43 | Scranton | .006837 | .10408 | -.05628 | -.12117 | -.01137 |
| 44 | San Antonio | .007156 | -.06335 | .08301 | .01894 | .03106 |
| 45 | Providence | .007654 | -.06029 | .14767 | -.01459 | .00030 |
| 46 | Birmingham | .008412 | .06606 | .08401 | .12114 | -.03807 |
| 47 | Philadelphia | .008425 | -.14390 | .01259 | .09151 | -.07142 |
| 48 | Allentown | .008602 | .12328 | .01062 | .09911 | .07202 |
| 49 | Portland | .009141 | -.04727 | -.04243 | .02228 | -.07359 |
| 50 | Albuquerque | .009398 | .04663 | -.07829 | .13778 | -.01383 |
| 51 | Little Rock | .009603 | .09851 | -.07695 | .11375 | -.00583 |
| 52 | Salt Lake City | .010321 | .04675 | -.00432 | -.03676 | -.07277 |
| 53 | Grand Rapids | .010850 | -.03711 | -.04140 | .07466 | -.17894 |
| 54 | Harrisburg | .011553 | -.07628 | .06949 | .05487 | .05385 |
| 55 | Pittsburgh | .011625 | .13554 | -.04937 | .11029 | -.01082 |
| 56 | Los Angeles | .011954 | .21319 | -.10131 | -.02614 | .10079 |
| 57 | Knoxville | .012235 | -.07375 | -.17772 | .04637 | .06401 |
| 58 | Springfield | .012290 | -.15681 | -.05563 | -.06911 | -.07973 |
| 59 | Hartford | .014279 | .02525 | -.17498 | .11299 | -.00766 |
| 60 | Fresno | .015894 | -.13455 | .09194 | -.16037 | -.11134 |
| 61 | Louisville | .017695 | .14111 | .13665 | .04437 | -.06779 |
| 62 | Youngstown | .018371 | -.05866 | .07688 | .11384 | -.25874 |
| 63 | Cleveland | .018588 | .04788 | .03232 | -.11236 | -.24418 |
| 64 | Boston | .023795 | -.22556 | -.01144 | .22203 | -.08636 |
| 65 | Milwaukee | .024715 | -.07353 | .25015 | .04820 | .15107 |
| 66 | Greenville | .026258 | -.05702 | -.03743 | .26701 | .09838 |
| 67 | Cincinnati | .027744 | .01196 | -.07483 | -.00786 | .33779 |
| 68 | El Paso | .028545 | .13757 | .07332 | .28081 | .09340 |
| 69 | Memphis | .034031 | .21119 | .25808 | .05099 | -.06663 |
| 70 | Minn.-St. Paul | .038910 | .01626 | -.41828 | -.03902 | .12633 |
| 71 | Rochester | .041007 | -.12714 | -.31161 | .08890 | -.05017 |
| 72 | Syracuse | .050655 | .15592 | .35621 | -.02378 | .06240 |
| 73 | Dayton | .150037 | .22878 | -.23591 | -.28939 | .79022 |
| 74 | Indianapolis | .209783 | -.38161 | .16409 | -.23921 | -.97113 |
| 75 | Raleigh-Durham | .375422 | -.38830 | -.04690 | -1.25794 | -.02750 |

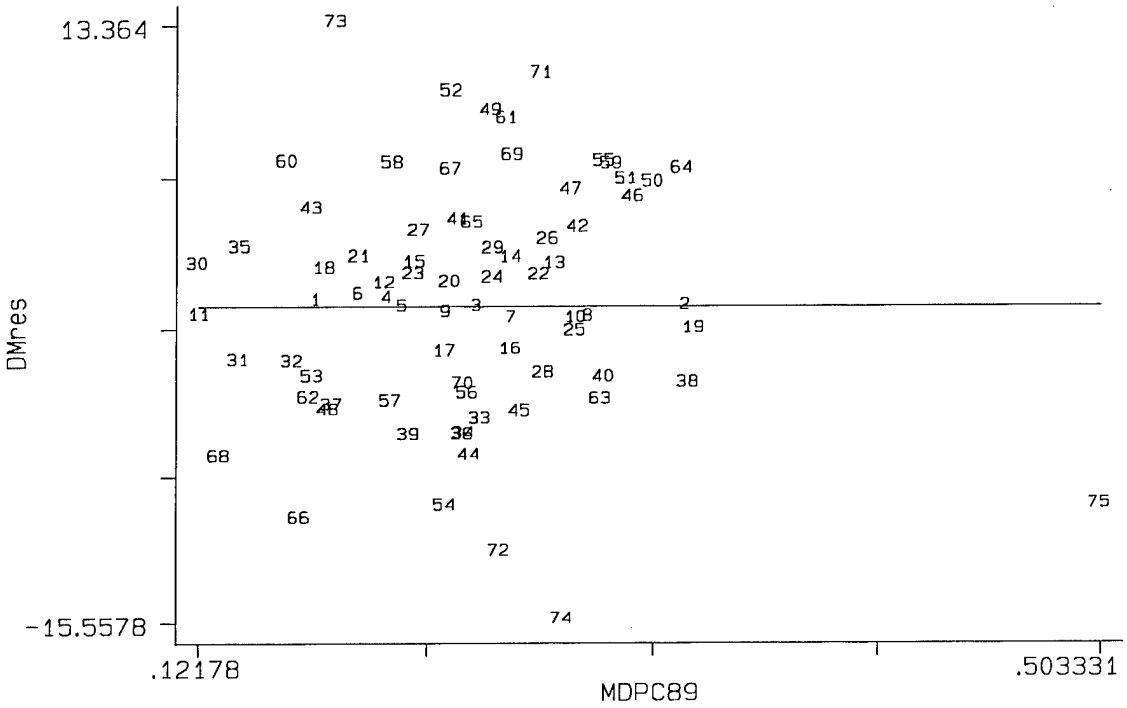
# Figure B7
# 1990s Plot of Residuals vs. Economic Growth Variable



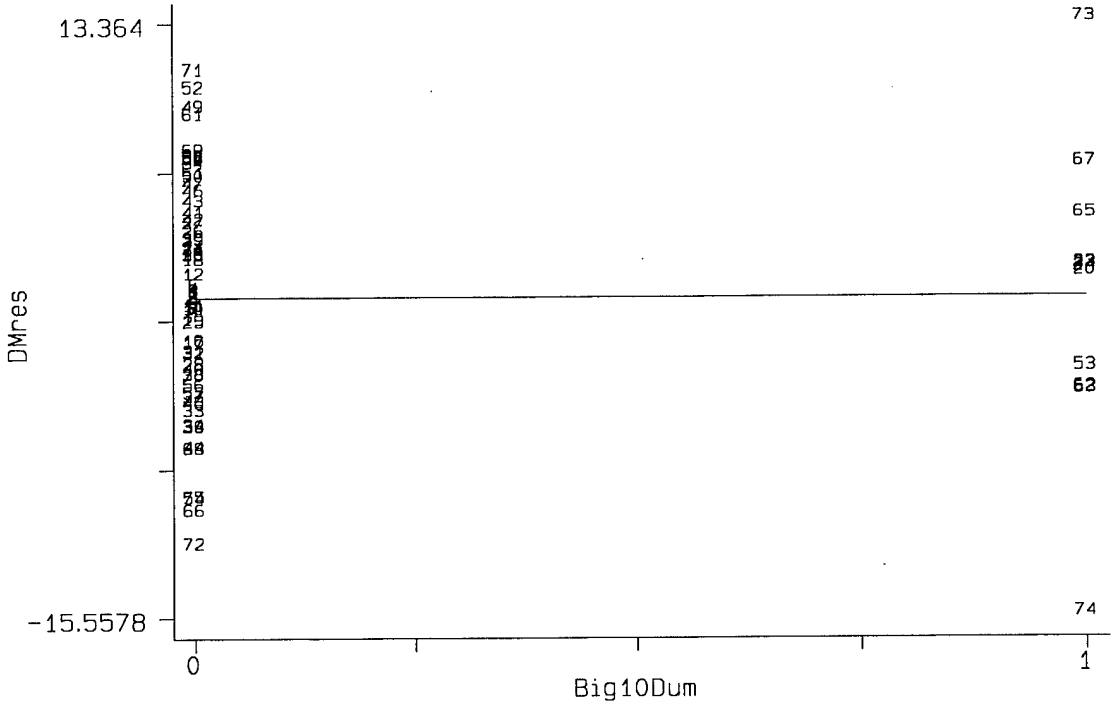
# Figure B8
# 1990s Plot of Residuals vs. Group Practice Variable



# Figure B9
# 1990s Plot of Residuals vs. MDs per capita



# Figure B10
# 1990s Plot of Residuals vs. Eastern Midwest Dummy Variable



# APPENDIX C
# DESCRIPTIVE COMPARISON OF EXPLANATORY VARIABLE VALUES

This appendix relates to material in Chapter 4, primarily Tables 4-4 and 4-5. Those tables provide descriptive statistics for the study's explanatory variables for the periods 1973-78 and 1988-93. This comparison of data for the 2 periods is offered for the purposes of providing information and possibly stimulating ideas concerning trends in a few of these variables. However, it should be noted that the 2 datasets are not completely comparable. As described in Chapter 3, the first dataset includes only 46 of the 75 MSAs that make up the 2nd dataset.

Table C-1 presents data from Tables 4-4 and 4-5 in a format that facilitates comparison across time. The mean values in all 3 of these tables are simple means of the values for the MSAs in each dataset. These means are not national means, nor are they population-weighted means for the included MSAs. Table C-1 only includes those 14 variables for which the mean values are substantively comparable.

Hospital statistics in Table C-1 are consistent with the national trend of declining hospital capacity and utilization during the 1970s and 1980s. Variable 1 shows that, by the measure used here, the number of hospital beds per 100 population went down from .472 in 1973 to .403 in 1989. Over the same period, the number of hospital days per 100 population (variable 6) declined from 1.32 to 1.02. Table C-1 reflects considerable inflation in hospital and other health care costs, with the estimated hospital expenditures per capita (variable 7) increasing from $213 in 1975 to $943 in 1990.

Table C-1 included 4 variables on the health care work force, namely variables 2-5 which respectively reflect concentrations of MDs, RNs, LPNs and Pharmacists. The table shows that the proportion of MDs increased by over 40% and the proportion of RNs more than doubled between the early 1970s and 1989 or 1990. For RNs, a more detailed examination of the data shows that the lowest value for 1990, .405, is higher than the mean value for 1972, .380. This suggests that the proportion of RNs went up in virtually every city included for both time periods. Interestingly, Table C-1 shows that the proportion of LPNs went down slightly, from .179 to .172 per 100 population, between 1974 and 1990. During that same period, the concentration of pharmacists increased by about 60%.

The table includes 2 variables that reflect characteristics of the physician population. The proportion of MDs aged 45-64, variable 10, went down moderately from .370 in 1975 to .343 in 1989. Since we have already seen that the MD population increased substantially during this period, it is understandable that the proportion of physicians under age 45 increased and the proportion ranging from ages 45 to 64 decreased. The table also shows a moderate increase in the percentage of physicians in group practice (variable 12); this is consistent with observed medical work force trends during this period. Variable 14, age of oldest HMO, is the final health care system variable in Table C-1. As would be expected, it shows that the age of the oldest HMO in the average MSA in these 2 datasets went up from 1978 to 1992.

**Table C-1: Comparison of Explanatory Variable Values For the 2 Analysis Periods**

All Information in this table is taken from either Table 4-4 or 4-5;
Please see those tables and the accompanying text for additional detail and explanation.

| # | VARIABLE | 1st Year Measured | Mean | Standard Deviation | 2nd Year Measured | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 1 | Hospital Beds per 100 population | 1973 | .472 | .091 | 1989 | .403 | .108 |
| 2 | MDs per 100 population | 1973 | .164 | .036 | 1989 | .235 | .060 |
| 3 | RNs per 100 population | 1972 | .380 | .101 | 1990 | .825 | .158 |
| 4 | LPNs per 100 population | 1974 | .179 | .038 | 1990 | .173 | .057 |
| 5 | Pharmacists per 100 population | 1974 | .051 | .011 | 1990 | .081 | .018 |
| 6 | Hospital Days per capita | 1973 | 1.32 | .268 | 1989 | 1.02 | .293 |
| 7 | Hospital Expenditures per capita | 1975 | 213 | 43.1 | 1990 | 943 | 206 |
| 10 | Proportion MDs Aged 45-64 | 1975 | .370 | .047 | 1989 | .343 | .040 |
| 12 | % Physicians in Group Practice | 1975 | 24.6 | 8.52 | 1988 | 28.7 | 8.9 |
| 14 | Age of Oldest HMO | 1978 | 10.9 | 13.2 | 1992 | 18.2 | 13.6 |
| 15 | Per Capita Income | 1978 | 7,700 | 741 | 1993 | 20,255 | 2,598 |
| 17 | Employees per Establishment | 1979 | 18.3 | 2.75 | 1993 | 16.0 | 2.04 |
| 18 | % Workers Union Members | 1976 | 25.2 | 9.04 | 1994 | 14.7 | 6.88 |
| 19 | Population Density | 1975 | 523 | 398 | 1993 | 527 | 365 |

The table includes 3 economic variables. The increase in average per capita income (variable 15) from $7,700 to $20,255 reflects a combination of economic growth and general inflation during the 1978 to 1993 period. The number of estimated employees per private establishment (variable 17) shows a decrease from 18.3 to 16.0 between 1979 and 1993. As discussed in Appendix A, this variable may not be measured completely accurately. However, this tentative indication of a substantial decline in average establishment size in thought provoking. The percentage of the labor force who are union members (variable 18) shows a decline from 25.2% in 1976 to 14.7% in 1994. This is consistent with well known trends.

Population density (variable 19) is the only demographic variable included in Table C-1. It shows a slight increase from 523 to 527 persons per square mile between 1975 and 1993. This increase is probably artificially low. Nine out of the nation's 10 largest cities already had operational HMOs in 1978, and they are included in the 1970s dataset. On the other hand, a large number of medium sized, relatively low-density cities, such as Memphis, Raleigh and Little Rock, were added to the 1990s dataset. It appears that the addition of these cities kept the average density of the 1990s dataset from surpassing that of the 1970s dataset by very much.

# APPENDIX D
# ALGEBRA OF HMO COST ESTIMATES

This appendix relates to material in Chapter 2, primarily Section A Nature of Cost Advantage. The conditions and methods that enabled HMOs to charge lower premiums were the subject of lively controversy in the 1980s and early 1990s. The following text was written to help clarify the nature of the controversy and the exact issues in dispute. However, recent empirical studies (Polsky and Nicholson 2001, Baker et al 2000 and Kemper et al 1999/2000) have provided new information and helped to resolve some of the questions. This algebraic analysis is made available for those who seek a more theoretical perspective from which to view the issues. Additionally, it is always possible that new data or analysis will revive controversy, and that such a theoretical approach will be needed.

In order to discuss research on premiums/costs, it will be helpful to refer to a few algebraic models. Relatively simple models can clarify the purpose of an otherwise confusing and disconnected series of studies. The basic finding of Luft's (1978) suggests a very simple model of medical care costs, which might be referred to as Model I or as the naive model. This model refers to average costs for a specific population, and it is assumed that everybody in the population is enrolled in either an HMO or an FFS insurance plan.

MODEL I

$$C = PH + (1-P)F$$

where

H = Average Cost per capita for HMO enrollees
F = Average Cost per capita for FFS enrollees
P = Proportion of the Population enrolled in HMOs
C = Overall Average Cost per capita for Medical Care

This model assumes that the average cost of enrollees in each system remains the same regardless of the level of P or any other factor. If this is true, and if H is lower than F, C can be minimized[10] by setting P=1, i.e. enrolling everybody in HMOs.

It is possible to construe favorable selection as a simple linear phenomenon affecting HMOs' costs and consequently premiums. This is done in Model II (next page).

[10] Within the feasible range

MODEL II

$$H = a + bP$$
$$F = c + dP$$
$$C = P(a + bP) + (1 - P)(c + dP)$$
$$C = c + (a + d - c)P + (b-d)P^2$$

where

C = Average Cost per capita for Medical Care
P = Proportion of the Population enrolled in HMOs
H = Average Cost per capita for HMO enrollees
F = Average Cost per capita for FFS enrollees
a = Intercept value for cost of HMO enrollees as enrollment approaches Zero. Is assumed to be positive.
b = Rate of change in HMO costs as enrollment increases.
c = Intercept value for cost of FFS enrollees when everybody is enrolled in an FFS plan.
d = Rate of change in FFS costs as enrollment decreases. The favorable selection hypothesis would imply that d is positive.

*In all models presented here, UPPER case letters symbolize directly measurable quantities, while lower case letters represent coefficients that can be quantitatively estimated.*

This model, and similar but less general models, can be used to structure our understanding of how HMOs affect health insurance markets. If HMOs consistently enjoy favorable selection, their average costs will go up as they enroll greater fractions of the population; that is to say coefficient b will be positive.[11] FFS costs will also increase as P increases in the presence of HMO favorable selection; coefficient d will also be positive. This is because FFS insurers are left with only the most expensive patients as HMOs enroll more of the population.

Under a very simple, but fairly reasonable set of assumptions, b and d are equal. If we then add a competition effect to the model, it would manifest as a reduction in the value of d. With appropriate further assumptions, the competition effect is equal to the difference between average cost escalations for HMO and FFS, namely b minus d. Even if HMOs are not any more cost efficient than FFS, they can still have a global cost reducing effect if they force FFS insurers to cut their costs.[12]

Ideally, Model II will be fleshed out with empirically determined facts concerning medical costs under HMO and FFS insurance. Determining a specific individual's costs at a specific time under two different insurance regimes necessarily requires a counter-factual scenario, and thus it is very problematic. But it is possible to use individual data to estimate FFS and HMO costs for very similar groups.

---

[11] Of course, the value of b need not be constant within the feasible range of P. But considering the full range of possibilities considerably complicates the modeling process and makes testing far more difficult.

[12] In this framework, HMOs are doing the "wrong" thing by favorably selecting enrollees, yet they get credited with a "good" result, namely cost containment. However, the less expensive or less risky enrollees also benefit from favorable selection, so the problem with selection is essentially one of income or utility distribution, not efficiency.

# APPENDIX E
# ILLUSTRATION OF POSSIBLE EFFECTS OF EXPLANATORY VARIABLES ON HMO ENROLLMENT

This appendix relates to material in Chapter 4, primarily the coefficients of the variables included in the final 1970s and the early 1990s models. Assuming that these associations reflect causal effects, these effects are illustrated for several hypothetical sets of circumstances here. This material is similar to the discussion in the first footnote to sub-section B5, Nurses In the Final 1970s Model, but it is more comprehensive.

For each of the 2 analyses, 1970s and early 1990s, 1 variable is excluded from this analysis and discussion. Latitude, which showed a statistically significant association for the 1973-78 period, is excluded. Logic argues against considering Latitude to be a causal variable when the units of analysis are cities. It is not possible to change a city's latitude without changing its fundamental identity. Therefore, Latitude is a control variable in the final 1970s model. Similarly, East Midwestern Location, which showed a statistically significant association for the 1988-93 period, is excluded from this discussion. It is not possible to change a city's east Midwestern location without changing the city's identity, so this variable is also treated as a control variable.

For the remaining 6 variables (counting Group Practice and MDs per capita twice), Table E-1 illustrates the possible effects of changes in values on HMO enrollment, expressed both in terms of market share and of typical total enrollments. The 3 suitable variables from the final 1970s model are listed first, followed by the 3 suitable variables from the final 1990s model. After the name of each variable, its mean, standard deviation and coefficient from the regression analysis are listed. (Please see Table 3-3 for the year of measurement for each of these variables.)

The 5th column in Table E-1 shows hypothetical changes in the z-score of the variable value for any city. In this table increases 1.0 and 2.0 standard deviations are postulated for each variable. Multiplying the values in the last 3 columns by –1 easily derives the possible effects of decreases of 1.0 and 2.0 standard deviations. The 6th column shows the result of multiplying the standard deviation by the change in z-score. It shows the change in explanatory variable value that could produce the effects shown in columns 7 and 8.

Columns 7 and 8 show the "Bottom Line" for this table. Column 7 shows the possible effect in terms of HMO market share; most of these values run between 1% and 3% of MSA population. Column 8 adds another hypothetical but plausible element by translating the market share effects into actual HMO enrollees for a "typical" city. For the 1970s, the typical city in this data set is assumed to have a population of one million. For the early 1990s, the typical population is increased to one million, two hundred thousand. Both these numbers are close to the mean and median population values for their respective data sets. These hypothetical enrollment effects range from a low of 7,585 to a high of 53,453.

One purpose of Table E-1 is to facilitate comparing the possible effects of different variables for the same time period. For the 1970s, the table indicates that the group practice of medicine may have had a greater effect than either of the other 2 variables. However, those 2 variables, MDs per capita and RNs per capita, appear to have had effects of similar magnitude. For the 1990s, this analysis indicates that economic growth may have had the greatest effect on HMO growth, a negative effect.

Also for the later period, the table can be interpreted as indicating that the 2 MD variables had negative effects of about the same magnitude.

In terms of both market share percentages and enrollees, the hypothetical effects for the early 1990s are somewhat greater than those for the 1970s. However, both the mean and the standard deviation for the outcome variable are considerably higher for the later period. Therefore, the higher numbers shown for the 1990s are misleading. Consistent with both the t and $R^2$ statistics shown in Tables 4-6 and 4-9, the 1970s model does better at explaining HMO growth of its period than does the 1990s model.

**Table E-1**
**Illustration of Possible Effects of**
**Explanatory Variables on HMO Enrollment**
Illustrative Changes and Effects Are Purely Hypothetical

| Explanatory Variable | Mean Value | Stndrd Dev. | Coeff. | Hypothetical z Change | Hypothetical Change of Value | Possible Effect HMOMS % | Hypothetical Enrollment Effect on "Typical" City (see note) |
|---|---|---|---|---|---|---|---|
| ***1970s ANALYSIS*** | | | | | | | |
| % MDs Gp Pract | 24.6% | 8.52% | 0.172 | plus 1.0 | 8.52% | 1.47 | 14,654 |
| % MDs Gp Pract | 24.6% | 8.52% | 0.172 | plus 2.0 | 17.04% | 2.93 | 29,309 |
| MDs/100 | 0.164 | 0.036 | 21.07 | plus 1.0 | 0.036 | 0.76 | 7,585 |
| MDs/100 | 0.164 | 0.036 | 21.07 | plus 2.0 | 0.072 | 1.52 | 15,170 |
| RNs/100 | 0.380 | 0.101 | 9.25 | plus 1.0 | 0.101 | 0.93 | 9,343 |
| RNs/100 | 0.380 | 0.101 | 9.25 | plus 2.0 | 0.202 | 1.87 | 18,685 |
| ***1990s ANALYSIS*** | | | | | | | |
| % Econ Growth | 164% | 29% | -7.68 | plus 1.0 | 29% | -2.23 | -26,726 |
| % Econ Growth | 164% | 29% | -7.68 | plus 2.0 | 58% | -4.45 | -53,453 |
| % MDs Gp Pract | 28.7% | 8.9% | -0.153 | plus 1.0 | 8.9% | -1.36 | -16,340 |
| % MDs Gp Pract | 28.7% | 8.9% | -0.153 | plus 2.0 | 17.8% | -2.72 | -32,681 |
| MDs/100 | 0.235 | 0.060 | -22.05 | plus 1.0 | 0.060 | -1.32 | -15,876 |
| MDs/100 | 0.235 | 0.060 | -22.05 | plus 2.0 | 0.120 | -2.65 | -31,752 |

Note: Reflecting population trends, the typical city of the 1970s is assumed to have 1,000,000 population, but the typical city of the early 1990s is assumed to have 1,200,000 population.

# APPENDIX F
# PRIOR EXPECTATIONS FOR STATISTICAL RESULTS

This appendix relates to material in Chapter 3. Sub-section B3 of this chapter summarizes how the initial hypotheses for the results of this study's statistical analysis were developed. The bulk of this appendix consists of the 2 memos, one dated 1996 and the other dated 1999, which stated and explained the initial hypotheses. Those interested in how the regression results compare with these 2 sets of expectations are referred to Chapter 5, sub-section B1, Comparison With Expectations.

## F1 – Memo Submitted Before Performance Of 1970s Regression Runs

Martin Markovich
RAND Graduate School

April 4, 1996
Ph.D. Thesis

### FINAL MEMO TO COMMITTEE BEFORE 1970s REGRESSION RUNS

Preparatory to running the 1st set of analyses for the Thesis, The Rise of HMOs, this memo will serve 2 purposes. Firstly, it will address some issues which were raised by Glenn concerning the factors that led to the successful establishment and robust growth of HMOs during the 1970s. In this connection, I will briefly address the impact of the Federal HMO Act, which was passed in 1973 and amended in 1976.

Secondly, this memo will discuss the specifications and my expectations for the analysis of HMO Market Share growth from 1973 to 1978. After briefly describing the data set I have compiled, it will detail the form of the dependent variable, the explanatory variables that will be used to estimate it and the specific units on which the analysis will be performed. There will also be discussion of subsequent supplementary analyses. Along with the specifications, I will list my expected results for these regressions. Naturally, unusually strong or surprising results may indicate modifications in the regression program and in the final form of the analysis.

A) Descriptive Analysis of HMO Growth in the 1970s

When Glenn Melnick and I met on March 1, we discussed the factors that led to HMO creation and growth, particularly how new HMOs marketed themselves to become viable. The period under analysis in this part of the thesis is 1973 to 1978, so I investigated the literature on HMO growth during this period. My primary source is the Brookings Publication, Politics and Health Care Organization: HMOs as Federal Policy, by Lawrence D. Brown; although this work is primarily intended to evaluate the effects of the Federal HMO Act of 1973, it also provides considerable background on the formation, management and success or failure of HMOs during the period. Page refences in this section refer to Brown's work.

In Chapters 2 and 3, Brown points out HMOs needed to create and maintain a delicate balance between several stakeholders. The management of each individual HMO had the critical task of keeping all these stakeholders committed to the organization. In the 1970s, each HMO, whether established or aborning, was unique in substance and background and there was no formula available for forming an HMO and making it thrive. There was still active resistance to the concept;

rapid growth was possible, but explosive growth was very unlikely because most providers were still suspicious of HMOs.

As described by Brown, 5 categories of stakeholders were essential to each HMO's success: a sponsor, subscribers, physicians, one or more hospitals and financial institutions. In some cases, the initial sponsor could also provide financial support, but most initial sponsors either didn't have sufficient financial resources or didn't see the HMO as essential to their operations. Some of the early sponsors included labor unions, both Blue and commercial insurance plans, foundations, industry, medical schools, groups of physicians and various levels of government. In many cases financial support had to be cobbled together from a combination of these and other sources, including bank loans.

Serious marketing to employers and their employees could only begin once the organization had a core staff of physicians (usually at least 6). In some cases the physicians brought their patients with them. However, most HMOs relied on marketing staffs to secure or increase their enrollment. Because HMOs really were new and different, enthusiastic marketing was necessary to overcome ignorance and risk aversion (Brown, pp. 84-85). HMOs that relied on Blue marketing staffs almost always were dissatisfied with the results because the needed sales approach was very different from that which worked for Blue plans (p.94).

Once the HMO began operation, word of mouth from satisfied customers became critical to expansion (p.95). However, satisfying customers required another delicate balance - between restriction of services and overutilization. The 2 primary forms of overutilization were unnecessary hospitalizations and referrals to fee-for-service specialists (p.87). The HMO's Medical Director played a critical role in establishing standards that would strike the balance while keeping their medical staff happy (p. 100). Given the difficulties involved, its not surprising that most young HMOs were in a "struggle for life itself." (p. 90)

Brown refers to the "fragility" of HMOs several times (pp.78, 127). This was in context of his perception of the disappointing growth of HMOs in the 1970s in response to the Federal HMO act. From the perspective of 1996, when HMOs enroll 56 million persons, collect over $75 billion in premiums annually and continue to grow at double digit percentage rates, the term "instability", conveying high potential for growth, decline or mutation, seems more correct. We see frequent formations, dissolutions, sales, mergers, divisions and prof ound changes in goals, affiliations and operating methods up to the present. For example, in the last 6 months of 1994, a relatively stable and prosperous period for HMOs, 85 out of 520 listings in the bi-annual InterStudy report changed, with half the changes stemming from the creation of new plans. The HMO story of the past 30 years is one of continued growth even as individual HMOs faced highly uncertain futures.

In summary, HMOs in the 1970s did not form or grow by using standard procedures or tactics. They had to strike and maintain a delicate balance between their stakeholders, and their policies and patterns of behavior were very varied, complex, difficult to measure and unpredictable. Quantification and statistical analysis of internal HMO operations during this period is nearly impossible.

Instead I am quantifying and analyzing the environments (MSAs)[13] in which each HMO operated. Because of the instability and sensitivity of HMOs to positive and negative factors affecting their well being, I expect to find certain environmental characteristics were more favorable

[13] For HMOs that didn't target the general private insurance market, non-geographic environmental factors were also important. Other target populations were primarily either Medicaid benificiaries or members of specific unions. Medicaid HMOs continue to be a separate category to this day (some HMOs serve both the general and Medicaid populations). Although Medicaid HMOs are probably influenced by MSA specific environmental factors, their existence poses problems for this analysis. However, HMOs that only served the membership of specific unions tended to expand into the general market or merge with HMOs that did.

than others; specifics are discussed later in this memo. In principle environmental conditions should have influenced a) the ability of HMOs to form and achieve viability, b) the willingness of stakeholders, many of whom reevaluated their affiliation continuously, to maintain participation, and c) the rate of hospital admissions and specialist referrals by HMO medical staff. My first goal is to determine which environmental factors had the greatest impact. But a more advanced goal is to assess whether each influential factor operated primarily through formation, continued affiliation or control of utilization.

Brown's book largely reflects disappointment with HMO growth in the 1970s because it had been believed that the Federal HMO Act would stimulate explosive growth in the number and enrollment of HMOs. Writing in 1982, Brown found that these expectations were unrealistic because of the difficulty of creating successful HMOs and opposition to HMO provision of health care. Brown's basic contention was that it would take time for HMOs to assume pre-eminence in the health finance system under any Federal policy short of mandating universal membership, and his position has been validated.

However, based on Brown's account, the subsequent evolution of the industry and the preliminary results of my analysis of HMO enrollment in 1973 and 1978, it seems clear that the act facilitated HMO growth in some ways, but impeded it in others. The Act publicized and legitimized the concept, which may have been its greatest contribution. The act sought to mandate that employers offer federally qualified HMO coverage to all employees (dual choice), but that provision was apparently never formally invoked. The act also offered a program of grants and loans for HMO establishment and expansion, Brown cites the Rhode Island Group Health Association (RIGHA) as an early recipient of a federal loan.

On the other hand, the act created confusion and even discouragement within many HMOs. The standards for federal qualification, including comprehensive coverage on a scale rarely seen even in Blue plans, community rating, open enrollment and others were completely out of touch with insurance industry practices then or now (some of these requirements were eliminated in the 1976 amendments). Paradoxically, these stringent requirements may have been more daunting to large well established HMOs than to newcomers who had little to lose. Specifically, Kaiser, on whose model the act was partly based, responded by reducing their expansion program in the face of continued uncertainty over federal policy. Brown cites a Kaiser spokesman who said "Kaiser didn't need federal money, and we really didn't need dual choice. ... So we decided to delay as long as possible our qualification and in the meantime work for amendments to the law." (p. 330)

On balance, the act didn't make much difference to overall HMO enrollment during its years of attempted implementation. In 1981, President Reagan discontinued the program for subsidizing individual HMOs and reduced the scope of federal activities to support HMOs in general. During the same period, Federal policy was changed to facilitate enrollment of Medicare and Medicaid beneficiaries by HMOs. HMO enrollment continued to grow, with almost all of the growth coming through the enrollment of private insurance policyholders. National enrollment grew from 10.2 million in 1981 to 33.6 million in 1990. Thus the HMO Act of 1973, as amended, stands as an interesting, but ultimately secondary factor in the colorful history of HMOs. The real action, as Brown discussed, lay elsewhere.

B) Specifications and Expectations

1) Data

The data set I have compiled has been discussed in the Draft Prospectus and other memos and presentations to the Committee. As you know, this study is looking at the 75 largest MSAs in the U.S. as of 1990. However, only those MSAs which had positive HMO enrollment in 1978 or

1973 are subject to the main analysis. This comes to 47 MSAs, sufficient to run and analyze regressions with several explanatory variables. Because of the relatively small number of observations, some results may have material substance but not pass the standard test of statistical significance.

The chief Outcome V will be the change in the percentage of the population enrolled in HMOs from 1973 to 1978 for each MSA. For example, if 2% of New Moscow's population were enrolled in HMOs in 1973, and 6% of its population were enrolled in 1978, than the outcome value for New Moscow would be +4%, regardless of any changes in the MSA's population over that interval. This V is referred to as StrDif.

Using log transformations of the market share variable was initially appealing because differences in logs should better measure compound growth. However, as Bob Bell pointed out, the log transformation presented 2 problems; it made it difficult to handle cases where HMO enrollment increased from 0%, and it assumed that MSAs with high HMS in 1973 would experience greater variance in growth in straight percentage terms. Inspection and analysis of the data did not bear out this assumption, and we concluded that the StrDif variable was more useful in measuring changes in HMO enrollment during this period.

A histogram showing the frequency distribution of the StrDif variable is attached. All but 2 of the MSAs show increases in HMO Market Share (HMS), and these fall into a fairly standard pattern. 25 MSAs experienced a small degree of growth, between 0.0 and 1.4% of their population. The density of the histogram basically decreases as it measures greater degrees of growth, and the 3 MSAs that display growth between 6.0 and 7.3% are the leaders.

These relatively low levels of growth reflect 2 central features of the HMO movement at this time: 1) the movement had enrolled small percentages of most urban populations up to that time, and, for reasons discussed in Section A, usually grew at only modest rates, and 2) the Kaiser system, which accounted for almost 60% of HMO enrollment in 1973 (Brown p. 401), was relatively stagnant during this period, partly because of uncertainty over the HMO Act.

More strikingly, the histogram also shows that 2 MSAs saw *decline* in HMS during this period; in one of these, market share went down by 14.8%, while the other registered a 2.6% decline. These 2 outliers reflect the instability of HMOs. In the MSA with the 2.6% decline a relatively small HMO went out of business between 1973 and 1978, leaving no HMO enrollment. In the MSA with the very large loss of market share, a large (for the time) HMO shrank drastically, reorganized and changed its name; Glenn suggested eliminating this conspicuous outlier from the analysis.

I expect to use the following explanatory variables, listed in 4 categories, in the analysis. All these Vs are for the period 1973-1975 unless indicated otherwise. Those Vs marked with an asterisk * are the focus of this analysis' primary hypotheses:

<u>Medical Supply</u>

BedsPC* - Hospital Beds per capita
MDPC* - Active Non-Federal MDs per capita
RNsPC - Registered Nurses per capita
LPNsPC - Licensed Professional Nurses per capita
PharmPC - Pharmacists per capita

<u>Other Medical System Measures</u>

HDPC - Hospital Days per capita (see below)
HXPC - Hospital Expenditures per capita (see below)
BMktSh73* - Percentage of population enrolled in Blue Cross or Blue Shield Health Insurance Plans
ErsCPD - Crude Measure of Hospital Costs per Day
StGr75p - Statewide Percentage of MDs who practiced in groups in 1975

StAMA71 - Statewide Percentage of MDs who belonged to the AMA in 1971
MDMAProp - Proportion of MDs aged from 45-64
AOldest - Age of Oldest HMO in 1978

General Economy

Incom78i* - Per capita Income in 1978
StU76 - Statewide percentage of workers belonging to Unions in 1976
EmptoE79 - Estimated Mean number of employees per Establishment in 1979

Demographic

RelLat - Relative Latitude (position along North-South axis)
RelLong - Relative Longitude (position along East-West axis)
PopDens - Population Density in 1978
Mig7077p - Net Migration from 1970 to 1977 as a percentage of population
MSchYr80 - Median Years of Schooling as of 1980

Issues have come up about a few of these variables. MSchYr80 is almost worthless because a value of "12" is recorded for almost every urban county in the U.S. (the documentation says that this variable is measured to tenths of years, but that's not the way the data is formatted). EmptoE79 is a very crude measure of employment concentration, calculated from some questionable assumptions, but I think its worth giving it a shot.

Several people have suggested using dummy variables for United States Region instead of Longitude and Latitude. I personally prefer the Longs and Lats because they reflect geographic reality more accurately, and, in the framework of regression assumptions, it is preferable to use continuous Vs instead of dummies whenever possible. I have "moved" Honolulu closer to the West Coast along the Longitude V so that it is less of an outlier. However, it is simple to use region dummies and see how their effect contrasts with that of the Longs and Lats.

The most critical issues concern the measurement of the related concepts of Supply, Utilization, and Expense. Four of the Vs measure these concepts: a) the number of hospital beds (BedsPC), b) the utilization of hospital bed-days (HDPC), c) expenses (and charges) per bed-day (ErsCPD) and d) hospital expenses per capita (HXPC). These variables are organically related, and will normally show a pattern of correlations.

In fact, the only case where 2 explanatory Vs show a correlation in excess of .9 is BedsPC and HDPC (r=.95). There was almost a perfect correspondence between the number of hospital beds in an MSA and the number of days these beds were occupied. This reflects very high hospital occupancy rates during this period. This result is a little disappointing because Hospital Beds and Bed-Days are distinct attributes and they could have different effects on HMO Market Share. The reality of that time does not permit analysis of this distinction, but the strong equivalence between Supply and Utilization simplifies the rest of the analysis.

Measuring costs is more problematic. The Area Resource File (ARF) offers a single figure for combined general and special hospital costs for each county for 1975; these have been aggregated to the MSA level. There are 2 principal ways of transforming this V so as to make it useful for cross-metropolitan comparisons. The 1st method is to compute costs per hospital bed-day, and the 2nd is to compute hospital costs per capita. Unfortunately, there are distinct problems with both derivative Vs.

The cost per hospital day V (ErsCPD) is theoretically preferable because it offers a measure of price. If accurately measured, this is an excellent index of overall health care costs. However, this V suffers from 2 technical problems. First, only expenditures for General and Special hospitals combined are available, but bed-days are only available for General hospitals I attempted to remedy

this problem by using 1981 data, which distinguishes between general and other bed-days and likewise with expenses. But the 1981 data was of poor quality, so this remedy was not possible.[14]

Secondly, the hospital expenditure figure includes outpatient as well as inpatient services. These problems mean that the dollar figure per bed-day is not meaningful, although the V could still be a reasonable index for comparing hospital expenditures per hypothetical unit of service across MSAs. Nonetheless, confidence that this variable reflects the desired facts must be lower than it is with most of the other Vs.

Interestingly ErsCPD showed a correlation of -.46 with HDPC (and a correlation of -.38 with BedsPC). Straightforward economic analysis would interpret this correlation as a reflection of movement along a demand curve, with areas with greater concentration of hospital beds forced to reduce charges in order to maintain high utilization rates. However, this result may be inconsistent with other studies that have found high utilization tends to coexist with high costs and charges.[15] Because the ErsCPD V is flawed to begin with, and because resoving these fundamental but poorly understood relationships is beyond the scope of this study, this controversial result makes ErsCPD less likely to be valuable in the analysis and interpretation of HMO Market Share.

The problems of ErsCPD do not apply to HXPC, hospital expenses per capita. In principal, including special hospital expenses and general hospital outpatient expenses is appropriate in measuring costs per capita. The problem with HXPC is a correlation of .67 with BedsPC (and a correlation of .65 with HDPC). This high correlation and the small size of the data set make it unlikely that the analysis will find distinct effects between the Supply and Expense measures.

My solution to these problems is pragmatic. The analysis will begin with the intention to test the hypothesis that supply of hospital beds (BedsPC) positively influenced the growth of HMOs in the mid 70s. However, I will also run regressions with the HXPC and ErsCPD variables. If particularly strong results appear, this will be suggestive for interpretation, evaluation and possibly subsequent research.

With the exception of the problems discussed above, the explanatory Vs are promising for regression analysis. Somewhat surprisingly, they all show considerable ranges and variances. For example, StU76 varied (in percents) from 6.6 to 37.1 with a mean of 25.3 and a standard deviation of 8.9. Histograms of these Vs show reasonable approximations of a normal distribution and few outrageous or inexplicable outliers. In general, these Vs show relatively low correlations with each other, reducing concern that the analysis will be marred by multi-collinearity. Out of 210 possible correlations between these 21 Vs, only 17 show absolute values in excess of .5.

2) Method

The explanatory Vs will be used to estimate the outcome (MSA change in HMO Market Share from 1973 to 1978) using Ordinary Least Squares linear regression. Because of the precautions I have taken, it is very unlikely that the change in HMO Market Share would have caused the observed values of any of the explanatory Vs, thus eliminating the problem of endogeneity. Of course, this does not necessarily mean that the causal relationship runs directly

---

[14] Conceptually, IF special hospital beds and bed-days were very highly correlated in 1981 and IF special hospital expenses were a fixed function of their days in 1981 and IF these relationships could be assumed to apply to 1975, THEN I could estimate the general hospital expense component for 1975 by subtracting imputed special hospital expense values from the total expenditures. In fact,general hospital expenidtures were missing from about half of the needed counties, making it impossible to compare general hospital expenditures for 1985 with those imputed for 1975. There were other inconsistencies in the 1981 data.

Although it would be possible to attempt further patches using data from still other years. I concluded that there would be inconsistencies and weaknesses in any estimate of cost per bed-day I could use.

[15] Try to find ref.

from the measured explanatory V to the outcome, even if the results are statistically significant. As discussed elsewhere,[16] 2 correlated variables could both be caused by an underlying phenomenon, or the explanatory variable may inded have a causal effect on the outcome, but only through a chain of causal effects which make the relationship harder to understand and less likely to apply to other situations.

Taking an approach which is more associated with statisticians than with econometricians, I will be open minded in ascertaining the statistical relationships between the outcome and the explanatory Vs. While results of prior studies indicate that certain relationships are likely, much of this analysis unprecedented in the published literature. Furthermore, most of the explanatory variables are distinct from each other, both conceptually and statistically. Therefore a major goal is to establish the strongest patterns within the data and to build upon the strong findings in making further inferences.

Modern software such as Stata offers the opportunity to run many regressions and at least make a quick assessment of the results of each one. Not only does this enable the analyst to try many specifications in search of the most meaningful results, but it is a substantial aid to understanding as well. My strategy in running these regressions will be to regress the outcome on each of the explanatory Vs individually in order to survey the statistical relationships. Simply examining the correlation table serves a similar function, but running regressions offers additional useful information from the coefficients.

Follwing the simple regressions, I plan to run a large number of regressions using 2 of the explanatory Vs in order to see how the explanatory power adds or overlaps. Regressions with more explanatory Vs will follow. Unless preliminary results show a major surprise, the main focus will be on testing the primary hypotheses, which concern the BedsPC, HXPC, MDPC, BMktSh73 and Incom78i variables. Where indicated, I will estimate non-linear or cross-product explanatory Vs, but the limited number of observations restricts the scope for analysis of more complex relationships.

Although I will be looking for strong patterns in the data, it is not wise to construct final results simply on the basis of those equations that yield the highest r-squared values. The final goal is to construct one or more equations that offer a coherent and useful account of the causes of variance in the outcome.

Regression diagnostics, including the examination of residuals, the identification of influential points and the graphical display of data, constitute a critical follow-up to the regressions. Besides confirming or challenging the assumptions of randomness, normality and independence, regression diagnostics can provide insights as to the essence of the results, suggestions for alternate functional forms and reliable interpretations.

3) Expectations

Expectations and hypotheses were discussed in detail in the Draft Prospectus of March 1995; the BMktSh73 variable was addressed in the Memo to Committee of February 1, 1996. Most of what follows repeats material from those 2 memos. Several of the variables listed on page 5 have never been utilized in statistical analysis of HMO enrollment. These include EmptoE79, RNsPC, LPNsPC and PharmPC. Strangely, geographic position, whether expressed in Longs and Lats or in Region dichotomous Vs, was not previously used.

[16] Markovich, M, Assignment 1, Tutorial on Causality, June 1995, unpublished, pp.3-4.

The regression analysis will test the effects of the following variables ( in 3 categories) on HMO Market Share. The expected results are indicated:

| | |
|---|---|
| Primary Hypotheses | |
| BedsPC | Positive |
| MDPC | Positive |
| BMktSh73 | Positive |
| Incom78i | Negative |
| New Variables | |
| HXPC | Positive |
| EmptoE79 | Positive |
| RNsPC | Positive |
| LPNsPC | No Effect |
| PharmPC | Positive |
| RelLong | Negative |
| RelLat | Positive |
| Old Variables | |
| AOldest (Control Variable) | Positive |
| ErsCPD | Positive |
| StU76 | No Effect |
| Mig7077p | Positive |
| StAMA71 | No Effect |
| StGr75p | Positive |
| MDMAProp | No Effect |
| PopDens | Positive |
| MSchYr80 | No Effect |

Naturally, it is unlikely that all the hypotheses listed above will be affirmed. Chances are most of the explanatory Vs will not show statistically significant or materially important effects. The Vs which I think are most likely to show significant effects are BedsPC, MDPC, Incom78i, AOldest, RelLong and Mig7077p.

The Draft Prospectus also discussed 2 other classes of hypotheses. The 1st of these concerned the use of prior period Vs to estimate HMO Market Share (HMS); the concept was that the prior values would have predictive power, but not as much as the current period Vs would. Because of the problem of causality, superior predictive power of current values may be moot; if the higher t-statistics are due to the endogeneity of the later values, then such results would say nothing about the causes of HMS (although they would say something about the causes of the values of the explanatory variables).

However, if other evidence or reasoning indicated that the explanatory Vs were not endogenous, then greater predictive power of current values would have 2 important implications. First, the contrast would show that the causal effect manifested itself in a shorter time than the period of the lag (which is generally about 4 years), and, second, it would show that these Vs are useful for generating short term (less than 2 year) forecasts.

The 2nd class of hypotheses concerned the comparison of results for the 2 periods, the mid-1970s and the early 1990s. While HMO enrollment nationwide grew at similar rates during these 2 periods, it is unclear whether similar forces were responsible at both times. If the 2 sets of regressions showed similar results, then this would be powerful evidence that causes of HMO growth remained strong over several decades. There are some technical problems with comparing

these 2 sets of regression results; the principle problems concern comparable construction of the dependent V, inclusion of the same explanatory Vs and measurement of the similarity/difference of the 2 sets of results. But these technical problems are surmountable if the data sets are sufficiently similar and if some additional analysis is performed.

However, this program has not been formally approved by the Committeee. With my imminent move to Florida and changes in my working environment, I need direction as to priorities in completing this Project. I am still ready to complete the parallel analyses if the Committee approves this plan. But, naturally, the analysis so far has suggested other directions which could produce insights and other paths to completion and approval of the Thesis. I would like to discuss this at the April Committee meeting, and I will present the options in a fuller and more structured way at that time.

4) Supplementary Analyses

Of the nation's 75 largest MSAs, 29 had HMOs with enrollment in 1973. From 1973 to 1978, HMOs were formed in 19 additional MSAs, while 1 MSA saw its only HMO go out of business. Ignoring the MSA which lost its only HMO, the MSAs can be logically divided into 3 classes: a) those that had HMOs in 1973 and kept at least some HMO enrollment, b) those that saw their 1st HMO formed between 1973 and 1978, and c) those that didn't have any functioning HMOs in 1973 or 1978.

Logically, any of 3 logit analyses can be conducted to distinguish the 3 groups of MSAs: a vs b&c, b vs c and c vs a&b. If MSAs qualified for the categories by a known deterministic process, than any 2 of these analyses would logically imply the results of the 3rd (i.e. if we know what caused MSAs to have HMOs by 1973 and what caused HMOs to form between 1973 and 1978 in those MSAs that didn't have them, then we should be able to imply what distinguished MSAs with no HMOs in 1978 from those that had HMOs). However, since all 3 analyses are subject to stochastic uncertainty, then it is possible they would produce results that are inconsistent or even conflicting.

But the regression analysis of HMO Market Share and the logit analysis of HMO existence may show very different results for substantive reasons. The factors that lead to the establishment of a first HMO with a small number of enrollees may be quite different than the factors that promote rapid growth by 1 or more HMOs in an MSA. For example, a prior study has found that per capita Income is positively associated with HMO presence, but negatively associated with HMO Market Share conditional on presence.[17]

However, should the logit analysis show results similar to that of the multiple regression analysis, then tobit analysis becomes an option. Tobit analysis would permit combination of data for MSAs with and without HMOs in 1978 and would offer greater statistical power.

[17] "An Empirical Analysis of HMO Market Share" by Morrisey and Ashby, Inquiry, Summer 1982, Table 2, p.143.

F2 – Memo Submitted Before Performance Of 1990s Regression Runs

Martin Markovich
Tallahassee, Florida

September 27, 1999
RAND Graduate School

FINAL MEMO TO COMMITTEE **EVER!!!**
PREPARATION FOR 1990s REGRESSION RUNS

This memo is comparable with the "Final Memo to Committee Before 1970s Regression Runs" of April 4, 1996. The 1st purpose is to provide some description of HMO growth during the 2nd analysis period, 1988-1993. This description will be helpful in explaining differential HMO growth across MSAs during this period and in forming hypotheses for the multiple regression analysis.

Secondly, this memo will delineate the specifications and hypotheses for the analysis. Data and specifications are very similar to those of the analysis of the 1st period, 1973-1978. Thus, only the distinctions and differences from the prior analysis will be emphasized. However, expectations, or hypotheses, are different from both the prior set of hypotheses and the prior set of results. Hence, expected regression results will be explained in detail.

A) Descriptive Analysis of HMO Growth From 1988-1993

Probably the most important factor influencing patterns of HMO growth during this period was the industry shakeout of the late 1980s. The explosive growth of the mid 1980s[18] was succeeded by an industry crisis from 1987-90. Many individual plans and a few national HMOs started losing money in the late 1980s. The most spectacular failure was Maxicare, which dropped from 2.2 million enrollees in 1986 to less than 300,000 in 1993.

During the shakeout period, some HMOs continued to prosper and keep growing. Overall national HMO enrollment continued to grow, but at a rate of less than 4% in both 1989 and 1990. The number of HMO plans declined, dropping from 662 in 1987 to 556 in 1990.

The main cause of the shakeout was that HMOs had proliferated and grew too quickly in the 1980s. As both enrollment and premiums rapidly increased, many HMOs became large corporations with tens or even hundreds of millions of dollars in annual revenues. But many of these organizations didn't have the structure, procedures or management skills to handle these responsibilities.

Lack of proper management made it difficult for some HMOs to control costs, which were rising rapidly during this period. Inept marketing may have caused some to suffer from adverse selection, which made other cost control mechanisms futile.

76 HMOs went out of operation completely from 1988 to the middle of 1990. Of these, 55, or 72%, were located in the South and Midwest. On the other hand, only 6 of the bankrupt plans were

[18] National HMO enrollment increased by over 20% during all 4 of the years from 1984 to 1987, and the increase in the number of plans was even faster.

located in the Northeast. The trends in shutdowns and enrollment suggest the Northeast was ready to adopt the evolving HMO concept which had originated in the West.

It is not entirely clear what attributes made the Northeast receptive to HMO growth during this period while the South and Midwest were less so. Possible explanations include the higher population densities in the Northeast, higher levels of medical costs there and the long-standing presence of a few HMOs in that region.

The worst effects of the HMO shakeout were felt by 1990. But most HMOs did not attempt to repeat the heady growth of the mid 1980s. By one measure, national annual enrollment growth remained under 7% through 1993. The total number of plans in the US did not start growing again until 1995.

The compound growth in enrollment of all HMOs combined with the reduced number of plans meant that by 1995 the average HMO had more than twice the enrollment of the average plan in 1987. Possible reasons include economies of scale, enhanced market power and greater financial stability of larger plans.

B. Specifications and Expectations

i. Outcome Variable

The Outcome variable (V) will be the change in the percentage of the population enrolled in HMOs from 1988 to 1993 for each MSA. This can also be referred to as the change in Market Share. For the 1973-1978 period, this V was non-zero for only 47 of the country's 75 largest MSAs. By 1993, HMOs had at least some enrollment in each of these MSAs, enabling me to conduct the analysis with more degrees of freedom (DoF).

There was considerable difficulty estimating HMO market share by MSA for 1993. This was primarily because many HMOs had significant enrollment in more than 1 MSA. Some Interstudy data assigning enrollment between MSAs (and in some cases to rural areas) was available, but it was fragmentary and inconsistent.

The estimates included in this data set were generated after careful scrutiny of available InterStudy data. In other cases, interpolating assumptions and specific knowledge of HMOs and MSAs was used to generate enrollment values, as had sometimes been necessary for the years 1973, 1978 and 1988.

Between the 2 periods, the substance of the outcome V changed in 3 notable ways. First, staff and group HMOs suffered a large decline in relative importance, as virtually all HMO growth occurred within IPA plans.[19] Most HMOs strove to give their subscribers an ever greater choice of physicians. Corresp-ondingly, a decreasing percentage of HMO physicians took all their patients from 1 HMO.

[19] InterStudy placed HMOs within 5 classifications, Staff, IPA, Group, Network and Mixed. HMOs classified as "Mixed" were essentially IPA HMOs which contracted with, but did not rely exclusively upon, large groups. By 1993, over 60% of HMO enrollment was in IPA or Mixed HMOs.

The 2nd change was the growth of Medicare and Medicaid HMOs. By 1993 Medicare HMOs enrolled 2.18 million people, and Medicaid HMOs had 1.92 million subscribers. These 2 purchasers were responsible for almost 10% of HMO enrollees.

The 3rd change was the emergence of point of service plans (POS) as a major type of HMO. POS enrollment accelerated from 1991 to 1993, and by July 1993, 2.3 million persons were enrolled in POS. Enrollment would climb to almost 6.3 million in 1996.

This entire analysis rests on the assumption that the HMO concept provides the crucial connecting thread between a wide diversity of HMOs across 2 decades. If one does not accept that assumption, then the results lose much of their meaning.

A histogram showing the frequency distribution of the Outcome V is attached as Figure 1. As shown, there are 2 mild outliers where HMO market share declined by over 15% of total population, and another 15 MSAs that saw smaller declines. 44 of the 75 cities saw growth of between 0% and 9%, and 12 MSAs saw growth of between 9% and 15%. In 2 cities, market share increased by more than 15% of total population.

For the 1970s analysis, one conspicuous outlier which saw a dramatic decline in HMO Market Share was eliminated from the analysis. This was justified on 2 grounds. 1st, this outlier would have had a dominant effect on all regression results under the specification chosen. But more importantly, there was reason to suspect that the high level of HMO enrollment reported for 1973 was spurious. If anything, the subsequent decline in "HMO" enrollment showed that resistance to the HMO concept was weakening in that MSA. [20]

I undertook a preliminary examination of the numbers and conditions of the 2 MSAs reporting the greatest decline during the 1988-93 period. Difficulties in accurately estimating enrollments make the extent of the declines somewhat uncertain. However, it is clear that both MSAs saw substantial declines in enrollment and that these declines were caused by the nationwide HMO shakeout.[21] Therefore, unless my current information on either of these 2 MSAs is substantially inaccurate, it is unlikely that dropping one or both from the analysis would be justified.[22]

The change in HMO growth at the MSA level between the 1973-1978 period and the 1988-1993 period is shown analytically in Table 1 below. Mean HMO growth in the 2nd period is almost double that of the 1st period. But both the standard deviation (S.D.) and the range (Max-Min) more than tripled between the 2 periods. This shows that, even when the higher overall level is accounted for, variability of HMO growth is greater in the 2nd data set.[23]

---

[20] According to most observers, the large HMO operating in Stockton in 1973 was not really an HMO but a physician sponsored front intended to pre-empt the entrance of Kaiser into that insular but rapidly growing community.

[21] The 2 MSAs are Indianapolis and Raleigh-Durham. In both cities, the Maxicare plan and 1 other large HMO lost most of their enrollment.

[22] However, it would be instructive to run the analysis without these 2 MSAs and conduct diagnostic analysis of influential points on the regression results with them included.

[23] If the outlier with large HMO Market Share loss were included, the relative variability for the 1st period would be comparable to that of the 2nd period.

TABLE 1
DESCRIPTIVE STATISTICS
FOR HMO MARKET SHARE
FOR THE 2 TIME PERIODS

| Period | Obs | Mean | S.D. | Min | Max |
|---|---|---|---|---|---|
| | | % | % | % | % |
| 1973-78 | 46 | 1.99 | 2.12 | -2.60 | 7.26 |
| 1988-93 | 75 | 3.78 | 6.59 | -17.94 | 18.40 |

ii. Explanatory Variables
The explanatory Vs used in the 1990s analysis are very similar to those used for the 1970s. It was not always possible to replicate the exact same variable, but most of the 1970s Vs have a very close analog in this data set. Table 2 lists 25 potential explanatory Vs.[24] Of these, 22 were tested in the 1970s analysis, and 23 will be tested in the 1990s analysis. MSA values for 2 of the 1970s Vs, Blue Cross/Blue Shield Market Share and A.M.A. Membership, were not available for the later period.

3 Vs that were not used in the 1970s analysis are being added to the roster of possible explanatory Vs for 1988-93. These are Population Growth from 1970 to 1993, Economic Growth from 1978 to 1993 and the proportion of MDs who were family practitioners (FPs) or general practitioners (GPs) during the 1989/90 period. These will be discussed in the expectations sub-section.

Table 2 shows that many of the explanatory Vs were measured in a straightforward and accurate manner for both of these periods. For a number of other Vs, minor technical problems arose, but the variable is still usable. For example, the 1st analysis used net migration from 1970 to 1977 as an explanatory variable, but the corresponding variable for the 2nd period is net migration for only 1 year, 1991. 2 Vs, hospital costs per day and average schooling are more accurate than they were for the earlier period.[25]

One major difference between the 1st and 2nd datasets lies in the degree of correlation among supply related variables such as Hospital Beds per capita and LPNs per capita. Among 21 explanatory variables for the 1970s, only 17 out of 210 possible correlations showed absolute values in excess of .5. Among the 22 explanatory variables for the late 80s/early 90s, 29 out of 231 possible correlations show absolute values in excess of .5.

Most of the high ($|r|>.5$) correlations for the later period are between supply related Vs such as Hospital Beds per capita and Licensed Practical Nurses per capita. The greater degree of correlation among these variables in the later period may be due to the imposition of increased market rationalization and discipline in the supply of health care resources.

---

[24] Actually, the 20th variable listed in the table, Regional Dummies, is a set of 8 closely related geographic Dummy variables.

[25] For the 1970s Hospital Costs per day V, only combined General and Special Hospital Costs were available for the numerator, while only General Hospital Days were available for the Denominator, producing a serious inconsistency. For the early 1990s, both costs and days are only for general hospitals.

Some of the other high correlations found within the 1990s data set are to be expected, such as the correlation of .75 between Population Mobility and Population Growth or the correlation of -.59 between MDs per capita and the proportion of Middle Aged (i.e. from 45 to 64) Mds. The other high correlations include a value of -.60 between the proportion of RNs and Population Growth.

The increased number of high correlations within this data set means that there is a greater danger of multi-collinearity influencing regression results. When collinearity or multi-collinearity is present among explanatory variables in a regression equation, estimated coefficients will tend to have large variances and small t statistics.

The simplest solution to multi-collinearity is to avoid having highly correlated explanatory Vs in a regression. Since most of my explanatory Vs are not highly correlated, and since I am trying to construct a relatively modest regression model with only 3 or 4 explanatory Vs, this problem is avoidable.

iii. Method

The method will be identical with that used for the 1973-78 period. The primary tool will be ordinary least squares multiple regression. It will be used to develop the statistical model which is most consistent with the data and contributes most to our understanding of the causes of HMO enrollment growth.

Numerous regression specifications using different combinations of Vs will be tested in search of the most structural model. For the 1 or 2 statistical models which show the most promising results, regression diagnostics will be applied to test the validity of statistical assumptions and to ascertain if any individual observations have a disproportionate influence on the model results.

One small addition to this regression program will be the inclusion of the model that was chosen from the analysis of the prior period. I found that HMO Market Share Growth was a function of 4 Vs, % of MDs in Group Practice, MDs per capita, RNs per capita and Employees per Establishment. Comparing the results of identical models for different periods will provide a crude index of the extent of change between the 2 periods.[26]

iv. Expectations

For the 70s analysis I developed 4 primary hypotheses, each referring to a specific explanatory variable. As it turned out, none of the 4 primary hypotheses were supported by the regression analysis. However, the development and statement of primary hypotheses helped to sharpen the analysis and improve understanding of the analytic results. This time the primary hypotheses all reflect my core belief that general economic and demographic Vs were more influential in the 1988-93 period than they were in the 1973-78 period.

Table 3 shows the same 25 explanatory Vs included in Table 2. For each V, the table shows the 1970s hypothesis, the 1970s result, and my hypothesis for the early 1990s analysis. Expectations are listed for 21 of these Vs, 9 of which are expected to show statistically significant effects. These 9 are discussed in this sub-section.

---

[26] I plan to calculate several statistical measures to estimate the extent of change in structural relationships and to test its statistical significance.

Hospital Costs per day, Age of Oldest HMO, Employees per Establishment, Population Density, Average Schooling and Proportion of Family Practitioners are expected to have a positive causal relationship with HMO enrollment growth. Net Migration, Population Growth and Economic Growth are expected to have a negative effect. However, Net Migration and Population Growth have a correlation of .75, making it unlikely that both Vs will show effects independent of each other.

I consider the expectations concerning, Economic Growth, Net Migration/Population Growth, Employees per Establishment and Population Density to be the most important hypotheses for the 1988-1993 period.

My expectation of ***negative*** effects from economic and demographic growth may be surprising at first, but these expectations are rooted in the descriptive analysis of HMO growth and dispersion during this period. The hypothesis is that the HMO boom of the mid 1980s saw aggressive growth in the most rapidly growing and changing metropolitan areas of that period and some of this growth was wiped out by the subsequent industry shakeout.[27]

The expectation of a positive effect of establishment size is based on similar reasoning. I believe that HMOs had aggressively marketed to smaller firms during the mid 1980s and that enrollment of small firm employees accounted for much of the growth of that period. However, marketing to small firms generates high administrative costs and considerable risk of adverse selection.[28]

Under this hypothesis, HMOs with contracts with large numbers of small firms went out of business or at least had to drop many of their small employer contracts. If this trend was pervasive enough, MSAs with smaller firms and establishments would have been less likely to see substantial enrollment growth during the 1988-93 period.

For the mid 1970s period, I had also hypothesized a positive causal effect of establishment size, but regression results consistently showed a small negative effect which didn't quite attain statistical significance.[29] Despite this, I'm hypoth-esizing a negative effect for the 2nd period, albeit for somewhat different reasons.

The expectation of a positive effect from Population Density reflects other changes in the nature of HMOs between 1978 and 1988. As they shifted from closed panels to more IPA type arrangements, HMOs were confronted with market pressures to provide consumers with the greatest possible choice of physicians and other providers. Assembling and supervising large provider networks was one of the critical challenges they faced during the 1980s and early 1990s, and the geographical dispersion of most American cities made the job harder.

---

[27] A contrasting hypothesis would be that, in the mid 1980s, HMOs grew most rapidly in the MSAs where they had previously had little or no presence. The bust tended to revert *relative* levels of HMO enrollment to those of the early 1980s. This hypothesis could be operationalized by making, say, 1983 market share an explanatory V for 1988-93 growth with an expected positive relationship (i.e. those MSAs with low HMO market share in 1983 would be expected to have less market share growth for the 1988-93 period).

[28] See Health Economics by Phelps, pp. 296-298.

[29] A positive effect was hypothesized in the belief that large paternalistic employers played a leading role in the growth of HMOs. However, the negative effect that was found suggests that, during the mid 70s, HMOs were more successful at marketing to the large diverse body of small employers than at securing contracts with large employers.

My hypothesis is that it was easier to develop and maintain large provider networks in denser MSAs. The reduced geographic dispersion in these cities may have facilitated meetings and other contacts between HMOs and providers. This hypothesis was suggested by the accelerated growth of HMOs in the Northeast while growth was slowing in the Midwest and South.

Complementary to the shift to larger networks was the increased use of primary care providers (PCPs). In some cases, HMOs encouraged their enrollees to designate a PCP on the grounds that the PCP could provide more continuous and coordinated care than a loosely connected set of specialized physicians. However, HMOs also required enrollees to have a referral from their PCP in order to see any other provider - i.e. the PCP was a gatekeeper.

Some HMOs liked to recruit Family Practitioners (FPs) or General Practitioners (GPs) to serve as PCPs. FP/GPs were oriented toward handling a wide variety of medical problems. Additionally, utilization and reimbursement of FP/GPs relative to specialists went down in the 1970s and 1980s, so they were available to contract with HMOs and provide care to large numbers of patients for economical rates. Therefore, the hypothesis is that those MSAs with higher concentrations of FPs and GPs were more likely to increase their HMO market share.[30]

Hospital Costs per day and Age of Oldest HMO were hypothesized to have a positive effect in the 1970s, but they didn't show any effect. For hospital costs however, there are 2 reasons to believe we will see an effect in the later period. First, both the overall cost level, adjusted for inflation, and the rate of price increase were higher in 1988-93 than they were in 1973-78. The cost driven component of HMO enrollment growth may be stronger for the later period.

Secondly, hospitalizations were a more significant cost factor for the Medicare population than for the commercially insured population. Since Medicare HMOs were paid 95% of the average fee for service Medicare expenses in their geographic sub-region, it is likely that blossoming Medicare HMOs in high hospital cost areas had additional resources with which to attract patients in these areas.

Likewise, Age of Oldest HMO did not show any effect in the mid 1970s. But state Medicaid administrators may have been influenced by knowledge of and familiarity with the HMO concept. Therefore, the Age of Oldest HMO in an MSA, or in a state, may have had a positive effect on Medicaid HMO enrollment, and, through that, on overall HMO market share in that MSA.

Finally, I hypothesize that Average Schooling had a positive effect on HMO enrollment during this period. This is because more educated consumers were likely to be attracted to Point of Service (POS) plans, which gave patients the option of going to out of network providers in return for a higher co-payment.[31]

---

[30] Subsequently, FPs did not dominate the gatekeeper role. Children generally were referred to Pediatricians for primary care, many women preferred to use their Ob/Gyns in this role, and Internists signed up to be gatekeepers for many people with chronic medical problems. Some HMOs allowed patients to list any network physician who was willing to play that role as their PCP.

[31] Admittedly, if a particular explanatory V ***only*** influenced one particular type of HMO, than that hypothesized effect would be better tested using enrollments in only that type of HMO. But its still worthwhile to test these hypotheses using overall HMO enrollments.

In sum, there are 9 hypothesized relationships that I expect to show causal effects in this analysis. However, the limitation imposed by only 75 observations makes it unlikely that all 9 variables will show a substantial effect in one regression equation.

5 of the hypotheses are intimately related to my belief that growth within MSAs during this period was more influenced by general demographic and economic conditions than by the characteristics of the health care industry. The other 4 hypotheses relate more specifically to certain aspects of HMO growth during 1988-93.

## Conclusions

This project was initially motivated by a simple observation. The large differences in the growth and levels of HMO enrollment in different cities provide a remarkable opportunity to understand the HMO industry and to consider alternative public policies toward HMOs.

The analysis of the 1973-78 period confirmed the judgement of many experienced health care managers and analysts, namely that the availability of providers and the receptivity of physicians specifically were critical elements in HMO growth during this early period. The forthcoming analysis of the 1988-93 period will show whether these elements continued to be important, or if broader demographic and economic factors played a stronger role as the HMO phenomenon continued to evolve.

HMOs were considered a very desirable form of health insurance across the policy analysis community when this project began. Ironically, they are now considered to be inimical to quality health care by many elected officials, and great pressure is being brought to render HMOs liable in Civil Court for real and alleged misdeeds.

The forthcoming analysis will test the 9 hypotheses described above and test for causal effects of the other Vs. Because of the strong results for the 1973-78 period, the results of the 1988-93 analysis are sure to be interesting and meaningful. The policy implications of both sets of results will be examined in the final report.

Selected References

InterStudy Edge - Special Edition, Managed Care: A Decade in Review 1980-1990, 1991.
InterStudy Competitive Edge Vol. 3, #2, 1994.
Phelps, Charles E., Health Economics, pp.296-298, 1992.

APPENDIX G
SUMMARY TABLE OF 3 PREDECESSOR ARTICLES

This appendix relates to material in Chapters 2 and 5. It presents a table summarizing 3 of the published articles on the growth of HMOs (Goldberg and Greenberg 1981, Morrissey and Ashby 1982 and Welch 1984). All 3 of these articles used data from the 1970s, making their results roughly comparable with the results of the first set of analyses performed for this study. Their results are summarized and discussed in Chapter 2, Section E, Causes of Enrollment Growth. This table provides additional detail. The results of this study are compared with the results of these previous studies in Chapter 5, sub-section B2, Comparison With Prior Studies.

**Table G-1**
**Summary and Comparison of 3 Prior Studies**
**On HMO Enrollment Growth**
All Numerical Values are t-Statistics
Please See Bibliography for Full References

| | Source of Statistics | | |
|---|---|---|---|
| | Goldberg and Greenberg | Morrissey and Ashby | Welch |
| Variable Name | Equation 6 | Equation V | OLS Eqn 2 |
| | | | |
| Per Capita Income | None | -1.65 | -1.65 |
| Extent of Unionization | 1.83 | 1.06 | None |
| Hospital Costs | 1.98 | None | 3.05 |
| Extent of Physician Group Practice | 1.8 | 0.72 | None |
| Population Mobility | 1.94 | 1.88 | -0.91 |
| State Regulation: Reserves Requirements | None | None | None |
| State Regulation: MD Employment | 0.46 | None | -2.55 |
| State Regulation: Certificate of Need (CON) | 0.16 | None | 2.25 |
| Lagged Values of HMO Enrollment | None | 6.36 | 23.7 |
| | | | |
| Note: Sign for Goldberg and Greenberg's t-stat for Population Mobility is reversed from the published statistic because the article uses a measure of Population Immobility. | | | |

# APPENDIX H
# RESULTS OF 3 SUPPLEMENTAL ANALYSES FOR THE 1970s

Supplemental analyses were conducted to assess the effects of certain decisions concerning the composition of the 1970s data set. The rationale for these analyses is presented in Chapter 3, sub-section B3 and the results are discussed in Chapter 4, sub-section B3. This appendix presents the numerical results of these 3 supplemental analyses.

Supplemental Analysis 1
Rerun 1970s Final Model on Data Set with 27 Cities (all of which had positive HMO enrollment in 1973)

. reg StrDif StGr75p MDPC RNsPC RelLat

| Source | SS | df | MS |
|---|---|---|---|
| Model | 115.909316 | 4 | 28.977329 |
| Residual | 42.6413422 | 22 | 1.93824283 |
| Total | 158.550658 | 26 | 6.09810224 |

| | |
|---|---|
| Number of obs | = 27 |
| F( 4, 22) | = 14.95 |
| Prob > F | = 0.0000 |
| R-squared | = 0.7311 |
| Adj R-squared | = 0.6822 |
| Root MSE | = 1.3922 |

| StrDif | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| StGr75p | .1585988 | .0320431 | 4.950 | 0.000 | .0921455 | .2250522 |
| MDPC | 15.4673 | 11.34786 | 1.363 | 0.187 | -8.066719 | 39.00132 |
| RNsPC | 15.60708 | 4.770113 | 3.272 | 0.003 | 5.714467 | 25.49968 |
| RelLat | -.0000164 | 5.89e-06 | -2.790 | 0.011 | -.0000286 | -4.22e-06 |
| _cons | -9.985598 | 1.923712 | -5.191 | 0.000 | -13.97513 | -5.996064 |

Supplemental Analysis 2
Rerun 1970s Final Model on Data Set with 74 Cities (the entire frame except for Stockton)

. reg StrDif StGr75p MDPC RNsPC RelLat

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| Model | 102.586661 | 4 | 25.6466653 | Number of obs = | 74 |
| Residual | 168.23103 | 69 | 2.43813087 | F( 4, 22) = | 10.52 |
| Total | 270.817691 | 73 | 3.70983138 | Prob > F = | 0.0000 |
| | | | | R-squared = | 0.3788 |
| | | | | Adj R-squared = | 0.3428 |
| | | | | Root MSE = | 1.5615 |

| StrDif | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| StGr75p | .1399291 | .0252945 | 5.532 | 0.000 | .089468 | .1903902 |
| MDPC | 7.495598 | 4.429943 | 1.692 | 0.095 | -1.341896 | 16.33309 |
| RNsPC | 6.504662 | 2.365279 | 2.750 | 0.008 | 1.78606 | 11.22326 |
| RelLat | -3.76e-06 | 4.22e-06 | -0.891 | 0.376 | -.0000122 | 4.65e-06 |
| _cons | -5.772938 | 1.191559 | -4.845 | 0.000 | -8.150032 | -3.395844 |

Supplemental Analysis 3
Logistic Regression Analysis of Operational HMO Establishment from 1973 to 1978

. logistic Exist78 StGr75p MDPC RNsPC RelLat

Logit Estimates

| | |
|---|---|
| Number of obs = | 47 |
| chi2(4) = | 5.38 |
| Prob > chi2 = | 0.2505 |
| Pseudo R2 = | 0.0848 |

Log Likelihood = -29.020726

| Exist78 | Odds Ratio | Std. Err. | z | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| StGr75p | .8623092 | .0753807 | -1.695 | 0.090 | .7265295 | 1.023464 |
| MDPC | 62.01632 | 486.5531 | 0.526 | 0.599 | .000013 | 2.96e+08 |
| RNsPC | .0672013 | .3143981 | -0.577 | 0.564 | 7.00e-06 | 645.1861 |
| RelLat | 1.000007 | 7.99e-06 | 0.901 | 0.367 | .9999915 | 1.000023 |

BIBLIOGRAPHY

ABBREVIATIONS

*Journals and Other Frequently Cited Sources*

AER - American Economic Review
AHL – American Health Line
AJPH – American Journal of Public Health
HA - Health Affairs
HCFR - Health Care Financing Review
HSR - Health Services Research
JAMA – Journal of the American Medical Association
JEL - Journal of Economic Literature
JEP - Journal of Economic Perspectives
JHE - Journal of Health Economics
JPE - Journal of Political Economy
MCRR - Medical Care Research and Review
MMFQ - Milbank Memorial Fund Quarterly
NEJM - New England Journal of Medicine
NYT - New York Times
QJE - Quarterly Journal of Economics
RWJ – Robert Wood Johnson Foundation
WSJ - Wall Street Journal

BIBLIOGRAPHY

Akerlof G "The Market for Lemons" QJE August 1970

American Health Line (AHL), "Quality: FFS Plans, MCOs Offer Comparable Care" (Report on RWJ Conference held in Princeton, NJ) May 21 2001 Item 8

AHL "PPOs: Only 13 States Currently Regulate" 3/22/01

AHL, "POS: Study Finds Few Enrollees Use Self Referral" May 3, 2001

Armstrong JS Long Range Forecasting: From Crystal Ball to Computer John Wiley & Sons 2nd ed 1985

Arrow, K "Uncertainty and the Welfare Economics of Medical Care", AER 53(5):941-973, 1963

Auger and Goldberg "PrePaid Health Plans and Moral Hazard" Public Policy 22:353-393 1974

Babbie E The Practice of Social Research Wadsworth, 6th edition 1991

Baker, Laurence Managed Care, Health Expenditures, and Physician Incomes: Three Essays on Health Economics Ph.D. Thesis Princeton University 1994

Baker and Cantor "Physician Satisfaction Under Managed Care" HA, Supplement 1993, pp.258-270

Baker, Cantor, Long and Marquis "HMO Market Penetration and Costs of Employer-Sponsored Health Plans" HA, Sept. 2000, pp 121-128

Bearden, Ingram and LaForge Marketing: Principles and Perspectives McGraw Hill 3rd ed. 2001

Blendon et al "Understanding the Managed Care Backlash" HA, July 1998, pp 80-94

Borowsky et al "Are All Health Plans Created Equal?" JAMA 278:917-921 Sept 17, 1997

Bothwell and Cooley "Efficiency in the Provision of Health Care: An Analysis of HMOs" Southern Economic Journal April 1982:970-984

Brealey and Myers Principles of Corporate Finance, Chapter 2 The Concept of Net Present Value and Chapter 7 Introduction to Risk and Return in Capital Budgeting, McGraw-Hill 2nd ed. 1984 (1st ed. 1981)

Brown, Lawrence A Innovation Diffusion: A New Perspective Methuen & Co 1981

Brown, Lawrence D Politics and Health Care Organization: HMOs as Federal Policy Brookings 1983
Campbell and Stanley Experimental and Quasi-Experimental Designs for Research 1963
Cave J "Equilibrium in Insurance Markets with Asymmetric Information and Adverse Selection" RAND R-3015 1988
Center for Studying Health System Change "Issue Brief: Policy Implications of Risk Selection in Medicare HMOs" November 1996
Chernew ME "The Impact of Non-IPA HMOs on the Number of Hospitals and Capacity" Inquiry, Summer 1995; 32(2) pp.143-154.
Christianson et al "The HMO Industry: Evolution in Population Demographics and Market Structures" Medical Care Review 48(1):3-46 1991
Coulam and Gaumer, "Medicare's Prospective Payment System: A Critical Appraisal", HCFR, 1991 Supplement: 45-77
Cromly and Shannon "The Establishment of HMOs:A Geographical Analysis" AJPH 73(2):184-187 1983
Cutler and Zeckhauser "Adverse Selection in Health Insurance" NBER Working Paper 6107, July 1997
Davis et al, Health Care Cost Containment, Johns Hopkins, 1990
Dick, Andrew, Seminar on Hawaii health insurance policies at the RAND Corporation circa 1993, publication unknown
Dowd et al "Health Plan Choice and Utilization of Health Care Services" Review of Economics and Statistics, February 1991: 85-93
Dranove, Simon and White "Determinants of Managed Care Penetration" JHE 17(1998) 729-745
Dudley and Luft "Managed Care In Transition" NEJM April 5 2001 pp 1087-1092
Enthoven A Health Plan Addison-Wesley 1980
Escarce et al "HMO Growth and Geographical Redistribution of Generalist and Specialist Physicians, 1987-1997" HSR October 2000 pp 825-848
Enthoven and Kronick "A Consumer-Choice Health Plan for the 1990s: Universal Health Insurance in a System Designed to Promote Quality and Economy" New England Journal of Medicine, 320:29-37 and 94-101, 1989
Farley D. Effects of Competition on Dialysis Facility Service Levels and Patient Selection (RGSD-109) Santa Monica, CA: RAND 1993.
Feldman and Dowd "The Effectiveness of Managed Competition: Results from a Natural Experiment" Presentation at the American Enterprise Institute, April 21-22, 1993
Feldman and Dowd "The Effectiveness of Managed Competition in Reducing the Costs of Health Insurance" 1993 pp 176-217 (This is Chapter 7 of a book)
Feldman and Sloan "Competition Among Physicians, Revisited" JHPPL 13(2):239-261
Feldman et al "The Effect of HMOs on Premiums in Employment Based Health Plans" HSR 27(6):779-811, 1993
Feldman et al "A Descriptive Economic Analysis of HMO Mergers and Failures, 1985 - 1992" MCRR June 1995 pp 279-304
Feldman et al "Economic and Organizational Determinants of HMO Mergers and Failures" Inquiry Summer 1996 pp 118-132
Feldman et al "HMOs: The Beginning or the End?" HSR 24(2):191-211 1989
Feldman et al "The Demand for Employer Based Health Insurance Plans" The Journal of Human Resources 24(1):115-142, 1989
Feldstein, Martin "The Welfare Loss of Excess Health Insurance" JPE, March-April 1973 pp.251-280
Fielding J Corporate Health Management Chapter 13 HMOs, Addison Wesley 1984
Foster, Mark S. Henry J. Kaiser - Builder In the Modern American West, University of Texas Press, 1989
Fuchs, V, "Economics, Health and Post-industrial Society" MMFQ, Spring 1979, pp153-182
Fuchs V, "Has Cost Containment Gone Too Far?" MMFQ 64(3) 1986
Fuchs, V, "The Health Sector's Share of GNP" Science 1990

Gabel et al "The Commercial Health Insurance Industry in Transition" HA Fall 1987:46-60
Gaskin and Hadley "The Impact of HMO Penetration on the Rate of Hospital Cost Inflation, 1985-93", Inquiry, Vol. 34, Fall 1997.
Galbi, Douglas, Seminar on Sickness Insurance in America circa 1900, presented at the RAND Corporation, February 16, 1993
General Accounting Office (GAO) California Public Employees' Alliance Has Reduced Recent Premium Growth November 1993
Given, R "An Economic Analysis of the California HMO Industry, 1986 -1992" Ph.D. Thesis, UC Berkeley Department of Economics, 1994.
Given, R "Economies of Scale and Scope As an Explanation of Merger and Output Diversification Activities in the HMO Industry" JHE, 1996 pp 685-713
Gold M "HMOs and Managed Care" HA Winter 1991:189-206
Gold and Hodges "HMOs in 1988" HA Winter 1989:125-138
Gold et al "Effects of Selected Cost Containment Efforts" HCFR, Spring 1993, 14:3 pp 183-225
Goldberg and Greenberg "The Determinants of HMO Enrollment and Growth" Health Services Research 16(4):421-438 1981
Goldberg and Greenberg The HMO and Its Effect On Competition 1977. (Released by the Federal Trade Commission)
Greenberg, Warren (ed.) Competition In the Health Care Sector: Past, Present, and Future 1978
Goldman and Leibowitz "Redistributional Consequences of Health Care Reform" Unpublished Draft November 1993
Griliches Z "Hybrid Corn: An Exploration in the Economics of Technical Change" Econometrica 1957 (25:501-522, referenced in Rogers 1995 and LA Brown 1981)
Gruber et al "From Movement to Industry: The Growth of HMOs" HA Summer 1988: 197-208
Hagerstrand, T The Propagation of Innovation Waves Lund Gleerup 1952 (referenced in LA Brown 1981)
Health Insurance Association of America Source Book of Health Insurance Data 1993 (referred to in footnotes as HIAA)
Holland P "Statistics and Causality" with Comments and Rejoinder, Journal of the American Statistical Association, December 1986
Home Textiles Today "Going Through the Life Cycle", January 21, 2002 (v.23, 20 19(1))
Hoy et al "Change and Growth in Managed Care" HA Winter 1991:18-36
Hurley and Ginsburg "Badly Bent Out of Shape: The Transformation of Traditional HMOs" Paper presented at the 8th Princeton Conference on the Future of Managed Care, May 2001
Iglehart J "The American Health Care System - Managed Care" NEJM 327(10):742-747 1992
InterStudy Competitive Edge - Industry Report 1994
InterStudy Competitive Edge, Vol.5, No.2, Part I HMO Directory, Part II Industry Report and Part III Regional Market Analysis, November 1995
InterStudy Competitive Edge, Vol.7, No.2, in 3 Volumes, 1997
InterStudy "HMO Enrollment Decreases, Though Decline Appears To Be Slowing" Press Release, 4/4/02
Jackson-Beeck and Kleinman "Evidence of Self-Selection Among HMO Enrollees" JAMA 11/25/83 Vol. 250, pp 2826-2829
Kemper, Reschovsky and Tu "Do HMOs Make a Difference? Summary and Implications" Inquiry Winter 1999/2000 pp 419-425
Kennedy, Peter A Guide to Econometrics MIT Press 1992
Kessel, Reuben "Price Discrimination in Medicine" Journal of Law and Economics Oct. 1958 (1st issue!) pp.20-53
Kimberly, de Pouvourville and Associates The Migration of Managerial Innovation, Jossey-Bass, 1993
Kimberly and Zajac "Strategic Adaptation in Health Care Organizations: Implications for Theory and Research" Medical Care Review Fall 1985:267-302

Kotler P Marketing Management: Analysis, Planning and Control Prentice Hall 1972 (referenced in LA Brown 1981)
Kotler and Armstrong Principles of Marketing (Activebook Version 1.0) Prentice Hall 2001
Kronick et al "The Marketplace for Healthcare Reform" NEJM 328(2):148-152 1993
Lehnard MN "Testimony before the US House Sub-committee on Health and Environment" (on behalf of the Blue Cross Blue Shield Association) March 24, 1999.
Levit et al "Health Spending By State: New Estimates for Policy Making" HA Fall 1993:7-26
Levit et al, "National Health Spending Trends in 1996" HA, 17:35-51, Jan/Feb, 1998
Levit et al, "Inflation Spurs Health Spending in 2000" HA 21:172-181, Jan/Feb, 2002
Long and Marquis, "The Uninsured 'Access Gap' and the Cost of Universal Coverage" HA Spring (II) 1994, pp.211-220
Los Angeles Times "Enrollment by Californians in HMOs Slipping" 2/20/02
Los Angeles Times "HMO 'Gag Clauses' On Doctors Spur Protest" 4/14/96, p A1
Luft and Miller "Patient Selection in a Competitive Health Care System" HA Summer 1988:97-119
Luft H "How Do HMOs Achieve Their Savings" NEJM 298(24):1336-1343 1978
Luft H HMOs: Dimensions of Performance Transaction Books 1987 (1st ed. 1981)
Manning et al "A Controlled Trial and the Effect of a Prepaid Group Practice on the Use of Services" NEJM 310:1505-1510 1984
Manning et al, "Health Care and the Demand for Medical Care: Evidence from a Randomized Experiment", AER, Vol 77(3):251-277, 1987
Markovich M "Final Paper: Application to HMS" revised, August 1995 (Unpublished)
Markovich "Final Memo To Committee Ever" September 27, 1999 (Unpublished)
Marquis and Long "Worker Demand for Health Insurance in the Non-Group Market" JHE May 17, 1995 pp 47-63
McKeown, Thomas "Determinants of Health" in Lee and Estes, ed., The Nation's Health James and Bartlett 1990. Original article published in Human Nature 1978.
McLaughlin C "HMO Growth and Hospital Expenses and Use: A Simultaneous Equations Approach" HSR June 1987 pp 183-205
McLaughlin C "Market Responses to HMOs: Price Competition or Rivalry" Inquiry Summer 1988:207-218 (McLaughlin 1988a)
McLaughlin C "The Effect of HMOs on Overall Hospital Expenses: Is Anything Left After Correcting for Simultaneity and Selectivity?" HSR August 1988, pp 421-441 (McLaughlin 1988b)
McLaughlin C "Effects of MCOs: What You See Depends on Where You Look and What You Ask" HSR (Editorial Column) October 2000 pp 757-760
McLaughlin et al "The Impact of HMO Growth on Hospital Costs and Utilization" in Advances in Health Economics and Health Services Research v5 JAI Press 1984
McNeil and Schlenker "HMOs, Competition and Government" Millbank Quarterly Spring 1975:195-224
Melnick and Zwanziger "Hospital Behavior Under Competition and Cost Containment Policies: The California Experience, 1980-1985" JAMA 260(18):2669-2675, 1988
Melnick et al "The Effects of Market Structure and Bargaining Position on Hospital Prices" JHE 11:217-233 1992
Merrill, Jackson and Reuter "Factors That Affect HMO Enrollment: A Tale of Two Cities" Inquiry 22:388-395 1985
Merrill and McLaughlin "Competition vs Regulation: Some Empirical Evidence" JHPPL 10(4):613-623 1986
Miller and Luft, "Managed Care Plan Performance Since 1980", JAMA, 271(19) 1512-1519, May 18, 1994.
Morrissey M Price Sensitivity in Health Care: Implications for Health Care Policy Washington DC The NFIB Foundation 1992
Morrissey and Ashby "An Empirical Analysis of HMO Market Share" Inquiry 19:136-149, 1982

Nelson, Richard R "A 'Diffusion' Model of International Productivity Differences in Manufacturing Industry" AER Dec. 1968 (Vol 58 (5), pp 1219-1248)
New York Times, "A New Formula for Health Plans" 7/28/95 p. D1
New York Times, "As 1 Million Leave Ranks of Insured, Debate Heats Up" August 27, 1995 p.1
New York Times "(Loosely) Managed Care Is In Demand" September 29, 1998 p. C1
New York Times "HMOs Flee Medicare Despite Rise In Payments" 12/4/01 p. A16
New York Times (NYT) "Anthem to Buy Virginia Blue Cross Plan" 4/30/2002
New York Times "HMOs For 200,000 Pulling Out Of Medicare" 9/10/2002
Newhouse, Joseph "Medical Care Costs: How Much Welfare Loss?" JEP Summer 1992
Pauly M "The Economics of Moral Hazard: Comment" AER 58(3):941-973 1968
Pauly, M., "Taxation, Health Insurance and Market Failure" JEL 24:629-675, 1986
Pauly, M. "Is Medical Care Different? Old Questions, New Answers" JHPPL 13(12): 227-237, 1988
Pauly and Redisch, "The Not-For-Profit Hospital as a Physicians' Cooperative" AER 63(1):87-99, 1973
Phelps, Charles E, Health Economics HarperCollins 1992
Pindyk and Rubinfeld, Econometric Models and Economic Forecasts McGraw-Hill 3rd Ed. 1991
Platt J "Strong Inference" Science, 1964, pp.347-353
Polsky and Nicholson "Why Are Managed Care Plans Less Expensive: Risk Selection, Utilization or Reimbursement?" Submitted to JHE March 2001
Popper K The Logic of Scientific Discovery Hutchinson 1959 (originally published in German 1935)
Porter, M. Competitive Strategy especially Chapters 1, 2 and 5, Free Press 1980
Poulier, JP "Health Data File: Overview and Methodology" HCFR 1989, Annual Supplement, pp.111-118
Reschovsky JD "Do HMOs Make a Difference? Data and Methods" Inquiry Winter 1999/20000 pp 378-389
Robinson J "HMO Market Penetration and Hospital Cost Inflation in California" JAMA 266(19):2719-2723, 1991
Robinson J "The Future of Managed Care Organization" HA March 1999 pp 7-29 (including Perspectives from Schaeffer and Volpe and from Halvorson)
Robinson and Luft "Competition, Regulation and Hospital Costs, 1982 to 1986" JAMA 260(18):2676-2681, 1988
Rogers EM Diffusion of Innovations Free Press 4th ed 1995 (1st ed 1962)
Rosenbloom and Sundstrom "The Sources of Regional Variation in the Severity of the Great Depression: Evidence from U.S. Manufacturing, 1919-1937" Journal of Economic History Sept. 1999 (Vol 59 (3), pp. 714-747)
Rothschild and Stiglitz "Equilibrium in Competitive Insurance Markets: An Essay in the Economics of Imperfect Information" QJE Nov. 1976
Russell, Louise B., "Some of the Tough Decisions Required By a National Health Plan" Science, 46:892-896, November 17, 1989
Safran et al, "Primary Care Performances In Fee For Service and Prepaid Health Care Systems: Results From the Medical Outcomes Study" JAMA, May 25, 1994, pp 1579-1586
Schwartz and Mendelson "Why Managed Care Cannot Contain Hospital Costs – Without Rationing" HA Summer 1992:100-107
Shain, Max, "The Change to Experience Rating in the Michigan Blue Cross Plan" AJPH, pp. 1695-1698, Oct. 1966
Sheils and Haught "Managed Care Savings For Employers and Households: 1990 Through 2000" Report to the American Association of Health Plans, May 23, 1997, The Lewin Group.
Short and Taylor "Premiums, Benefits and Employee Choice of Health Insurance Options" Journal of Health Economics 8:293-311, 1989.
Silicon Valley / San Jose Business Journal "PC Industry Mature, Future Sales Growth To Be Jagged" May 10, 2002, p.23

Somers and Somers Doctors, Patients and Health Insurance The Brookings Institution 1961
Southam A "The Southern California HMO Marketplace: Growth, Innovation and Integration" Journal of Ambulatory Care Management 14(3):1-8 1991
Stapleton, David C. "The Impact of HMOs on Health Care Spending Growth" Report by Lewin-VHI May 1995
Starr P The Social Transformation of American Medicine Basic Books 1982 (referred to in footnotes as STAM)
Statistical Abstracts 1988 and 1994
Stigler, George, "The Theory of Economic Regulation", Bell Journal of Economics, Spring 1971, pp 3-21
Sullivan, Kip "On the 'Efficiency' of Managed Care Plans" HA July 2000: 139-148
Takiff J "Gamers Rejoice: $E^3$ Started With Price Wars and Got Better", Tallahassee Democrat June 10, 2002, p.1D
Tu, Kemper and Wong "Do HMOs Make a Difference? Use of Health Services" Inquiry Winter 1999/2000 pp 400-410
U.S. GAO "Health Care Spending: Nonpolicy Factors Account for Most State Differences" HRD 92-36 1993
USA Today "Slump Hangs Up Cellphone Makers" 6/12/02
Vladeck, Bruce "The Market vs Regulation: The Case For Regulation" MMFQ Spring 1981 pp 209-223
Wall Street Journal "Study Criticizing Consumer Price Index Is Disputed by Labor Statistics Bureau" 12/20/96 p.A2
Wall Street Journal, article on Cardiac Procedures in Lubbock, Texas, 7/16/96 pp.1, 5
Ware et al, "Differences in 4 Year Health Outcomes For Elderly and Poor, Chronically Ill Patients Treated in HMO and Fee For Service Systems", JAMA, Oct. 2, 1996, pp 1039-1047
Weiss Ratings "HMOs Return to Profitability Earning $990 Million" Press Release 8/6/2001 Accessed at www.weissratings.com/NewsReleases/Latest/index.htm 8/13/2001.
Welch WP "The Elasticity of Demand for HMOs" The Journal of Human Resources 21(2), 1986
Welch WP "HMO Enrollment: A Study of Market Forces and Regulations" JHPPL 8(4):743-758 1984
Welch and Frank "The Predictors of HMO Enrollee Populations: Results From a National Sample" Inquiry 23:16-22, 1986
Whitmore H "Policy Implications of Risk Selection in Medicare HMOs: Is the Federal Payment Rate Too High?" Issue Brief #4 by the Center for Studying Health System Change 1996
Wholey et al "The Effect of State Regulation on Development of HMO Markets" Advances in the Study of Entrepreneurship, Innovation and Economic Growth (4) JAI Press 1990
Wholey et al "The Effect of Market Structure on HMO Premiums" JHE 1995 pp 81-105
Wholey et al "Scale and Scope Economies Among HMOs" JHE 1996, pp 657-684
Wilson C "The Nature of Equilibrium in Markets with Adverse Selection" Bell Journal of Economics 11(1):108-130 1980
www.cabletvadbureau.com/01Facts/factscontents.htm "2001 Cable TV Facts: Complete List of Contents" Accessed 5/25/02
Zellner and Wolfe "HMO Growth and Hospital Expenses: A Correction", HSR August 1989 with Author Response and Rejoinder, pp 409-429
Zwanziger, Melnick and Bamezai "The Effects of Selective Contracting On Hospital Costs and Revenues" HSR October 2000 pp 849-867